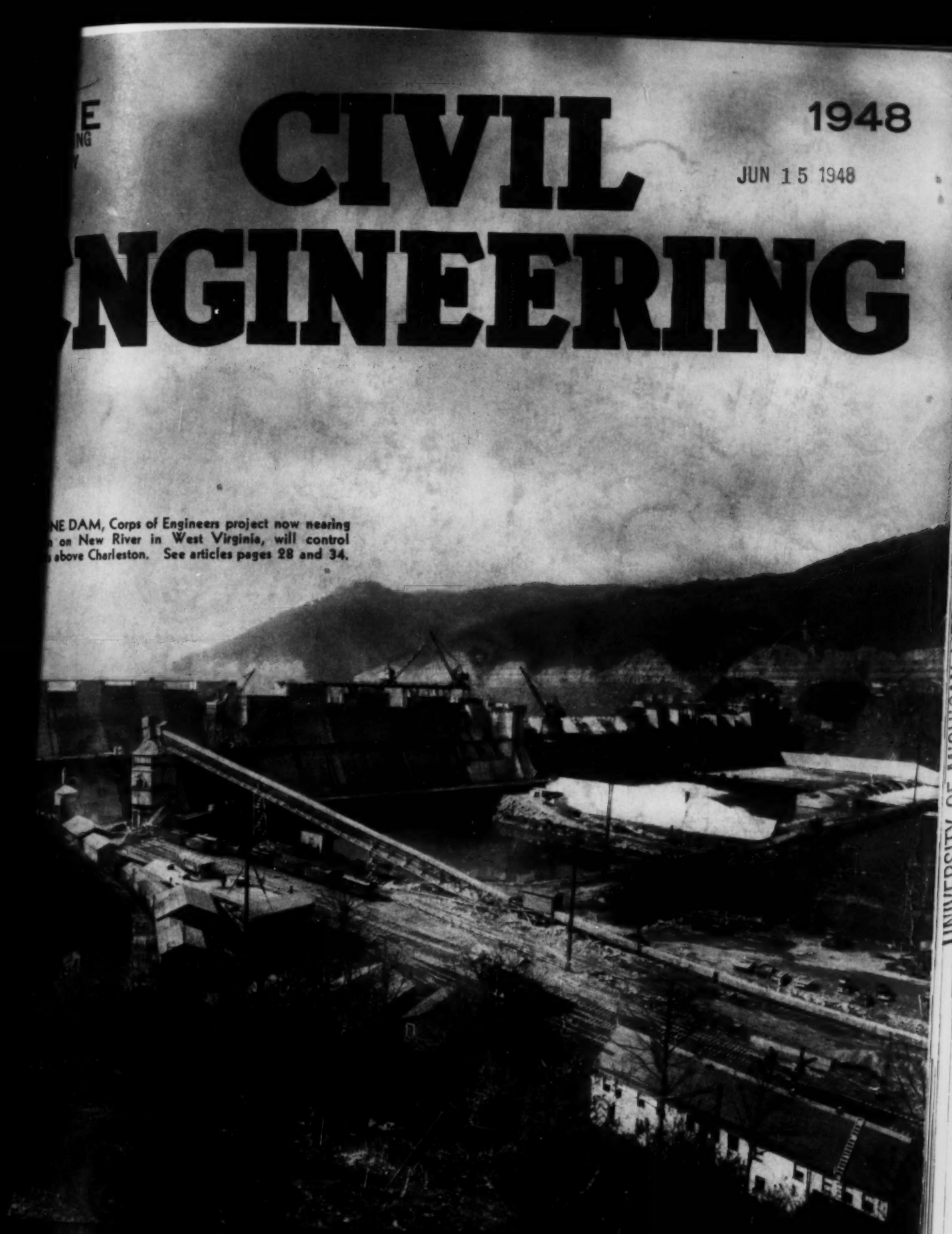
CIVIL ENGINEERING

1948

JUN 15 1948



NE DAM, Corps of Engineers project now nearing
on New River in West Virginia, will control
above Charleston. See articles pages 28 and 34.

Highway Program Calls for New Design and Construction Techniques—Olee

Economy in Materials Handling Features Bluestone Dam Construction—Auhl

Role of Federal Government in Hydro Power Development—Pettit

Steel-Framed Structures Alleviate Britain's Housing Problem—Lee

ASCE SUMMER CONVENTION—SEATTLE, WASH.—JULY 21-24, 1948

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1948 Annual Convention of ASCE

Seattle, Wash., July 21–24, 1948

OLYMPIC HOTEL, HEADQUARTERS

Registration—Spanish Lounge, Olympic Hotel, Tuesday, July 20—2:00 to 9:00 p.m., Wednesday, July 21—8:30 a.m.

General Business Meeting, Wednesday, July 21

10:00 A.M. OLYMPIC BOWL, OLYMPIC HOTEL

Welcome to Seattle

By Seattle Section:

BERTRAM P. THOMAS, President, Seattle Section, Senior Engineer, Corps of Engineers, Seattle District.

By City of Seattle:

HON. WILLIAM F. DEVIN, Mayor of Seattle.

Response—Presidential Annual Address

RICHARD E. DOUGHERTY, President ASCE; Vice-President, New York Central System, New York, N.Y.

Annual Convention Business Meeting

Economic Aspects of Development of Columbia River Power

EUGENE L. GRANT, Professor of the Economics of Engineering, Stanford University, Palo Alto, Calif.

Sessions of Technical Divisions, Wednesday Afternoon

General Session on Cost Allocation

Sponsored by Engineering Economics Division

2:30 P.M. JUNIOR BALLROOM

Presiding: Charles H. Blackman, Member, Executive Committee, Engineering Economics Division

Report of Committee on Cost Allocation of Multiple-Purpose Water Projects

F. W. SCHEIDENHELM, Consulting Engineer, New York, N. Y.

Discussion

EUGENE L. GRANT, Professor of the Economics of Engineering, Stanford University, Palo Alto, Calif.

Construction Division

2:30 P.M. OLYMPIC BOWL

Presiding: Kirby Smith, Chairman, Executive Committee, Construction Division

2:30 Unwatering of Davis Dam

A. H. AYERS, Engineer, Utah Construction Co., San Francisco, Calif.

Discussion

3:15 Construction for Columbia Basin Irrigation

L. VAUGHAN DOWNS, Associate Engineer, U.S. Bureau of Reclamation, Grand Coulee Dam, Wash.

Discussion

A. J. DAVIDSON, Chief, Engineering Section, U.S. Bureau of Reclamation, Ephrata, Wash.

4:00 Unit Price Bids

R. E. ROTHSCHILD, JR., Haas & Rothschild, San Francisco, Calif.

Air Transport Division

2:30 P.M. PARLOR A

Presiding: Alfred J. Ryan, Chairman, Executive Committee, Air Transport Division

2:30 Runway Strengths for Air Carrier Operations

WILLIAM C. HILL, Oregon State Board of Aeronautics.

AUTHOR: HENRY AARON, Paving and Soils Division, Civil Aeronautics Administration.

Discussion

3:15 Runway Dimensional Standards for Air Carrier Operations

RICHARD T. PUCKEY, Superintendent of Airports, Seventh Region, Seattle, Civil Aeronautics Administration.

CO-AUTHORS: RICHARD T. PUCKEY and PAUL STAFFORD, Assistant Director, Airport Engineering Service, Civil Aeronautics Administration, Washington, D.C.

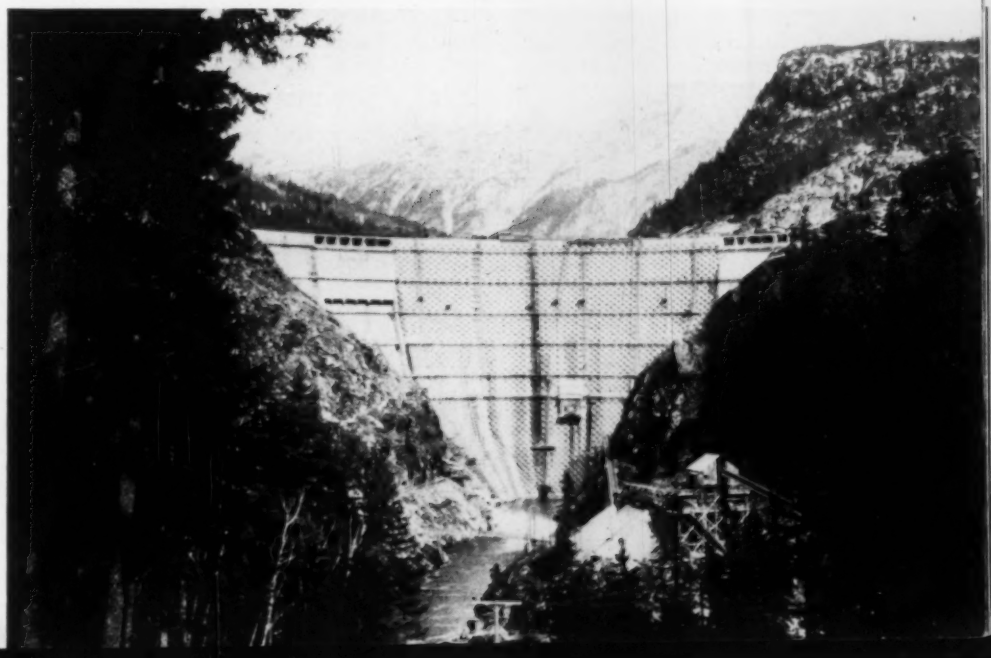
Discussion

4:00 Segmented Circle Marker System

EVERETT C. CRITES, Chief, Standards Coordination Division, Civil Aeronautics Administration, Washington, D.C.

Discussion

USE OF HIGH-STRENGTH CONCRETE in Ross Dam, under construction on Skagit River by City of Seattle Department of Lighting, is described in paper by H. F. Faulkner at Structural Division session on Thursday morning, July 22.



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Social Activities, Wednesday, July 21

12:15 General Luncheon—Georgian Room—Olympic Hotel

ADDRESS BY

DR. PAUL J. RAVER, Administrator, Bonneville Power Administration, Portland, Ore.

Golf: On Seattle's outstanding courses for those who wish to play.

FOR THE LADIES: Tea at the Seattle Art Museum.

2:30 Leave Olympic Hotel for Seattle Art Museum in Volunteer Park

MRS. A. M. YOUNG will describe the history and operation of the museum after which guided tours of the museum's permanent exhibits will be conducted.

5:00 Return to Olympic Hotel

FOR LADIES AND MEN:

6:15 Cocktail Hour—Spanish Lounge—Olympic Hotel

7:30 Dinner—Spanish Ballroom

10:00 Dancing and Bridge—Spanish Ballroom and Parlor A (Semi-formal)

Sessions of Technical Divisions, Thursday Morning, July 22

Power Division

9:00 A.M. OLYMPIC BOWL

Presiding: E. H. Collins, Chairman, Committee on Operation and Maintenance of Hydroelectric Generating Stations, Power Division

9:00 Potentialities of Coordinated Development of Power in Columbia River Basin

R. WAYNE LINCOLN, Senior Engineer, Corps of Engineers, Seattle District.

Discussion

9:45 Northwest Power Markets

BARRY DIBBLE, Consulting Engineer, Redlands, Calif.

Discussion

10:30 Practical Measures of Coordination Among Columbia River Basin Power Projects

A SYMPOSIUM BY REPRESENTATIVES OF THE NORTHWEST POWER POOL

Presiding: E. N. Peterson, Coordinator, Northwest Power Pool, Portland, Ore.

Participating: Representatives from

Washington Water Power Co., Spokane
Puget Sound Power & Light Co., Seattle
City of Seattle, Department of Lighting
City of Tacoma, Light Division, Department of Public Utilities
Pacific Power & Light Co., Portland, Ore.
Portland General Electric Co., Portland, Ore.
Bonneville Power Administration, Portland, Ore.
Utah Power & Light Co., Salt Lake City

Structural Division

9:00 A.M. JUNIOR BALLROOM

Presiding: Stewart Mitchell, Chairman, Committee on Forces Acting on Structures, Structural Division

9:00 Wood Bridges

T. K. MAY, Director of Engineering Service, West Coast Lumbermen's Association, Portland, Ore.

Discussion

9:45 The Use of High-Strength Concrete for Ross Dam

HERBERT F. FAULKNER, Construction Engineer (Ret.), City of Seattle, Department of Lighting.

Discussion

10:30 Planning for a Second San Francisco Bay Crossing

RALPH A. TUDOR, Chief Engineer, San Francisco Bay Toll Crossings Division, California Department of Public Works.

Discussion

Waterways Division

9:00 A.M. PARLOR A

Presiding: Robert W. Abbett, Chairman, Committee on Ports and Harbors, Waterways Division

9:00 The Development of the Port of Seattle

G. T. TREADWELL, Chief Engineer, Port of Seattle.

Discussion

GEORGE F. NICHOLSON, Consulting Engineer, Los Angeles, Calif.

9:45 Facilities at the Port of Long Beach

R. R. SHOEMAKER, Chief Engineer, Harbor Department, City of Long Beach, Calif.

Discussion

10:30 Recent Contributions of Wave Research to Harbor Engineering

J. W. JOHNSON, Associate Professor, Mechanical Engineering, University of California.

Social Activities, Thursday, July 22

FOR THE LADIES:

10:00 a.m. Leave Olympic Hotel for tour of Seattle gardens

1:00 p.m. Luncheon at Women's University Club

4:00 p.m. Leave Olympic Hotel for scenic drive through the University of Washington Arboretum and Campus

6:00 p.m. Dinner—Edmund Meany Hotel—University District

8:30 p.m. Theater Party at University of Washington's two distinctive theaters, The Penthouse and The Showboat

Golf: On Seattle's outstanding courses for those who wish to play.

FOR THE MEN:

6:15 p.m. Leave Olympic Hotel

6:45 p.m. Cocktails at Rainier Golf and Country Club

7:30 p.m. Dinner

9:30 p.m. Entertainment

10:30 p.m. Leave Rainier Golf and Country Club

11:00 p.m. Return to Olympic Hotel

NOTE: There is no luncheon scheduled for the men on Thursday in order to permit time for informal gatherings.

Sessions of Technical Divisions, Thursday Afternoon, July 22

Construction Division

2:00 P.M. OLYMPIC BOWL

Presiding: Kirby Smith, Chairman, Executive Committee, Construction Division

2:00 **Construction of Willamette Valley Flood Control Project**

O. E. WALSH, Colonel, Corps of Engineers; District Engineer, Portland, Ore.

Discussion

2:45 **Unusual Design and Construction Features of North Santiam Highway**

J. F. CAMERON, Senior Highway Engineer, Public Roads Administration, Portland, Ore.

Discussion

3:30 **A Large Earthmoving Project**

O. H. TUCKER, JR., Project Manager, Macco Corp. and Morrison-Knudsen Co., Inc., San Bruno, Calif.

Discussion

4:15 **Building a Concrete Causeway with Precast Units**

BEN C. GERWICK, President, Ben C. Gerwick, Inc., San Francisco, Calif.

Discussion

Soil Mechanics and Foundations Division

2:00 P.M. PARLOR A

Presiding: Allen S. Cary, Chairman, Seattle Section Soil Committee, Soil Mechanics and Foundations Division

2:00 **Three-Dimensional Electrical Analogy, Seepage Studies at Foster Creek Damsite**

NEIL H. TWELKER, Associate Engineer, Seattle District, Corps of Engineers.

Discussion

2:30 **Foundation Analysis, Springston Damsite, Coeur d'Alene River, Idaho**

CONSTANTINE A. NOVIE, Associate Engineer, Seattle District, Corps of Engineers.

Discussion

3:00 **Analysis of Clay Foundation, Meridian Damsite, Willamette River, Ore.**

HARRY R. CEDERGREN, Senior Engineer, Portland District, Portland, Ore.

Discussion

3:30 **Analysis of Pile Foundations with Batter Piles**

ALEXANDER HRENNIKOFF, Assistant Professor of Civil Engineering, University of British Columbia.

Discussion

Structural Division

2:00 P.M. JUNIOR BALLROOM

Presiding: Stewart Mitchell, Chairman, Committee on Forces Acting on Structures, Structural Division

2:00 **A Proposed Loading for Highway Bridges**

T. Y. LIN, Assistant Professor of Civil Engineering, University of California.

Discussion

2:45 **A Floating Tunnel Across Puget Sound**

C. E. ANDREW, Chief Consulting Engineer, Washington Toll Bridge Authority, Tacoma, Wash.

Discussion

Excursions, Friday, July 23

Tour of Boeing Aircraft Co. plant where B-50, successor to the Superfortress, and Stratocruisers are being manufactured

9:15 a.m. Leave Olympic Hotel for Boeing Aircraft Co.

10:00 a.m. Tour starts through Boeing plant

11:15 a.m. Tour completed

12:00 a.m. Return to Olympic Hotel

Tour of U.S. Navy's Puget Sound Navy Yard, home of heavy warships

9:30 a.m. Leave Olympic Hotel for Bremerton, Wash.

10:45 a.m. Arrive at Puget Sound Navy Yard

1:00 p.m. Luncheon at Officers' Club, Puget Sound Navy Yard

2:30 p.m. Leave Navy Yard

3:30 p.m. Return to Olympic Hotel

Boat Trip over Seattle's lakes and Puget Sound by way of Lake Washington Ship Canal and Locks, including close-up of floating concrete pontoon bridge on Lake Washington

4:30 p.m. Leave Olympic Hotel

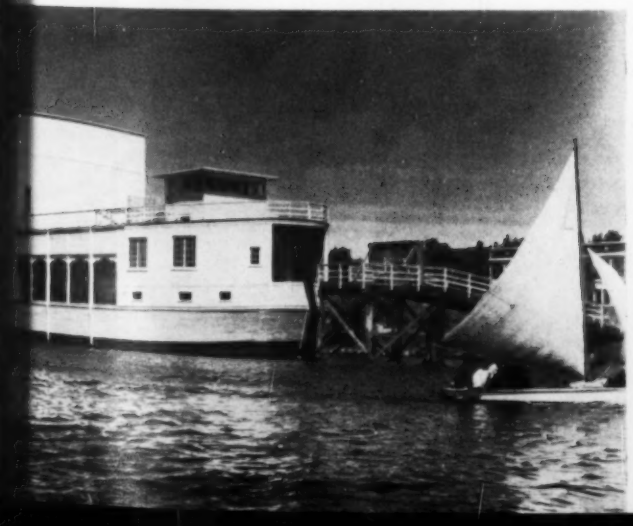
5:30 p.m. Boat leaves Leschi Park, Lake Washington. Supper served en route

8:00 p.m. Boat docks at Pier 54

8:30 p.m. Return to Olympic Hotel

PROGRAM FOR LADIES attending Convention includes special dramatic presentation at Showboat Theater of University of Washington, on shore of Lake Union, Thursday evening, July 22.

FLOATING CONCRETE PONTOON BRIDGE spanning Lake Washington at Seattle can be seen on Friday boat trip over Seattle's lakes and Puget Sound via Lake Washington Ship Canal and Locks.



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MUD MOUNTAIN DAM on White River, earthfill flood-control structure completed just before war by U. S. Corps of Engineers, Seattle District, is one of goals of Saturday excursion, July 24.

Excursion, Saturday, July 24

8:00 a.m. Leave Olympic Hotel
9:30 a.m. Arrive White River Lumber Co.
A logging demonstration will feature the topping of a Douglas fir as a spar tree.
12:00 m. Arrive at Mt. Rainier National Park (Yakima Park)
Luncheon at Park Cafeteria, Sunset Lodge
4:00 p.m. Arrive at Mud Mountain Dam
6:30 p.m. Return to Olympic Hotel, Seattle

General Announcements and Reservation Form

Hotel Accommodations

Headquarters for the 76th Annual Convention will be the Olympic Hotel at the corner of 4th and Seneca in downtown Seattle. Requests for reservations at the headquarters hotel must be made early, for they will be handled in order of receipt. When the Olympic's available rooms are reserved, the Hotel Committee will make reservations in nearby comparable hotels.

For convenience in making all hotel reservations use the special request form provided on this page.

Hotels	Rates Single	Rates Double
Olympic, 4th and Seneca (Convention)	$3.50 up	$5.00 up
Benjamin Franklin, 1930 Fifth Ave.	3.00 up	4.50 up
Camlin, 1619—9th Ave.	4.00 up	5.00 up
Edmund Meany, E. 45th & Brooklyn	3.00 up	4.00 up
New Washington, 2nd & Stewart	3.00 up	4.00 up

Tourist Courts	Rates
Ace Motor Hotel, 8512 Aurora Ave.	$5.00 up
Motel Ben Coral, S. 141st St., U.S. 99	3.00 up
Greenlake Motel, 8900 Aurora Ave.	6.00 up
Mayberry Motor Court, 9600 Aurora Ave.	5.00 up

Local Sections Conference

A conference of representatives of Local Sections of ASCE in the West and Northwest will be held in the Olympic Hotel on Monday and Tuesday, July 19 and 20, preceding the general meeting.

This conference, while primarily for appointed delegates of the Sections, will be open to any who may be specially interested in the activities of ASCE Local Sections.

Ticket Cost

Event	Per Person
Wednesday Noon Luncheon	$2.25
Wednesday Afternoon Ladies' Tea	Complimentary
Wednesday Evening Dinner Dance	4.00
Thursday Noon Ladies' Luncheon	1.50
Thursday Evening Men's Smoker	3.00
Thursday Evening Ladies' Dinner and Theater Party	3.00
Friday Excursions:	
To Boeing Aircraft Plant } Alternates	No charge
To Puget Sound Navy Yard } Alternates	3.00
Boat Trip	3.00
Saturday Excursion to Mt. Rainier National Park	3.00

(All ticket prices include cost of meals.)

General Announcements

Clothing. Summer in the Pacific Northwest is delightful; neither extra light nor extra heavy clothing will be required. It will be advisable to take a light topcoat.

Trips. The possibilities of combining attendance at the Summer Convention with a vacation trip are almost without limit. Therefore, to avoid competition with publishers of travel guides (and to conserve space in CIVIL ENGINEERING) it will only be suggested that some of the finest vacation country in the United States lies on your way to, or from, Seattle.

Local Committee on Arrangements

Fred H. Rhodes, Jr., *General Chairman*
E. B. Crane, *Vice-Chairman*
B. P. Thomas, *President, Seattle Section*
T. H. Campbell, Jr., *Secretary-Treasurer, Seattle Section*
F. B. Farquharson, *Chairman, Technical Program*
H. M. Hadley, *Chairman, Hotel*
E. L. Strandberg, *Chairman, Registration*
Cecil Arnold, *Chairman, Entertainment*
C. M. Howard, *Chairman, Excursions*
George Teufel, Jr., *Chairman, Finance*
Dudley F. Stevens, *Chairman, Publicity*
Walter A. Averill, *Chairman, Reception*
Neil Lane, *Chairman, Transportation*
A. L. Miller, *Housing Reservations*
Mrs. B. T. Thomas, *Women's Program*

Seattle Annual Convention of ASCE
Olympic Hotel, July 21–24

(Please Print)

Name .....

Street .....

City ..... Zone ..... State .....

PROF. A. L. MILLER
Hotel Committee, ASCE
Civil Engineering Department
University of Washington
Seattle 5, Wash.

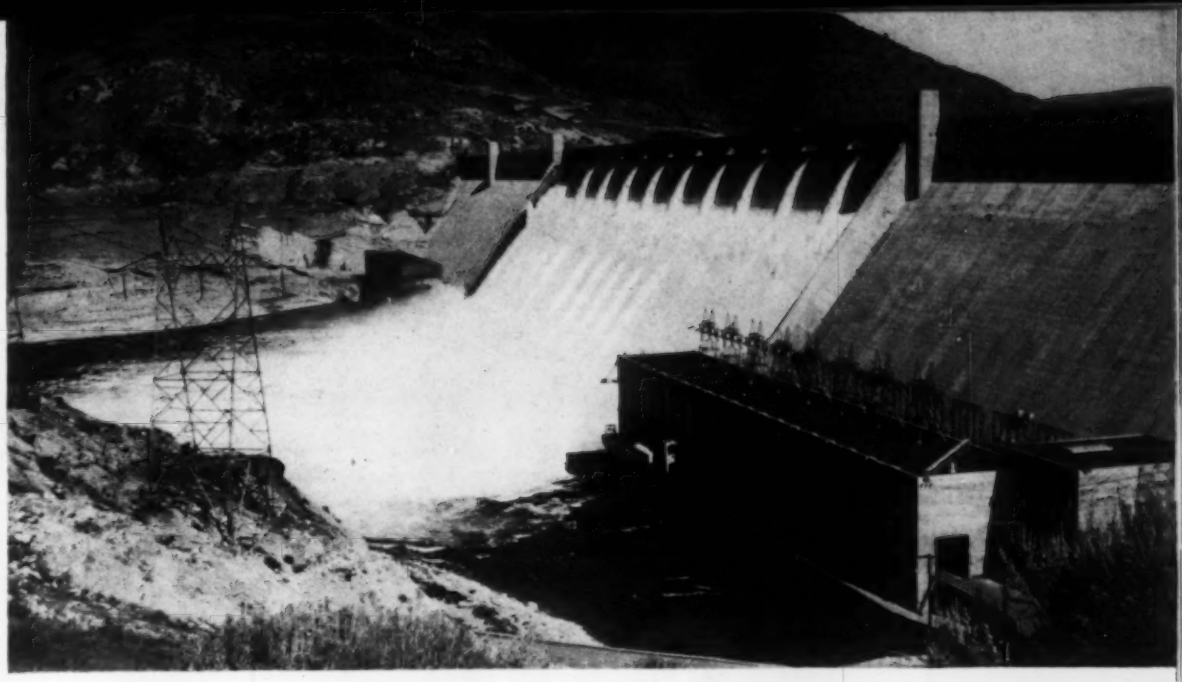
Please reserve for my occupancy the following hotel space:

Double ..... Single .....

Double, twin beds ..... Suite .....

Other .....

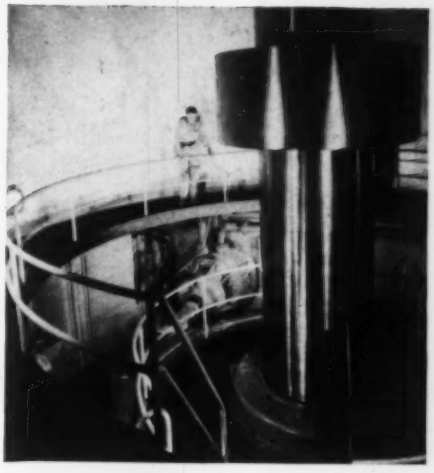
Dates of occupancy .....



LARGEST CONCRETE RIVER BARRIER constructed by man, Grand Coulee Dam on Columbia River is key structure in Columbia Basin Project. Self-liquidating 1,029,000-acre irrigation project is in south central part of State of Washington. West Powerhouse, nearest to camera, already contains its full complement of nine generators. East Powerhouse can also be seen in view.

New Unit Increases Generating Capacity at Grand Coulee Dam

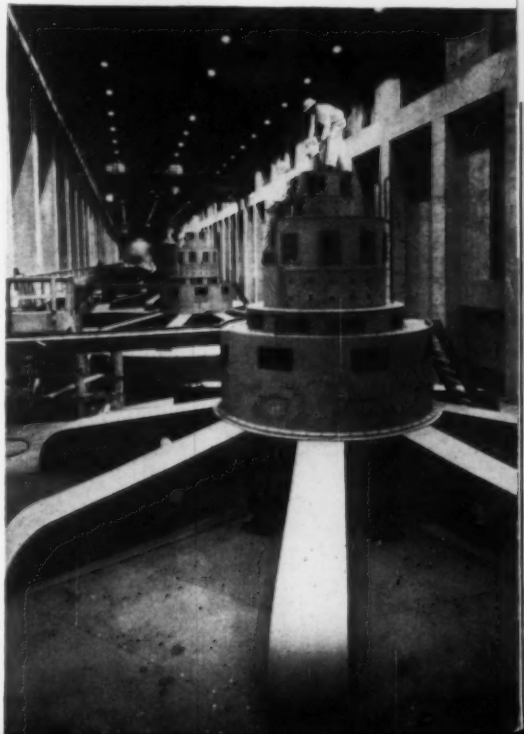
GRAND COULEE DAM and its giant hydroelectric power installations can claim a half dozen world's records. Attention was centered recently on West Powerhouse (in foreground of the view above) when its ninth and final generator went into production to meet the needs of the power-hungry Pacific Northwest. The West Powerhouse now has a rated capacity of 1,330,000 hp, with a peaking capacity of more than 1,500,000 hp. Across the Columbia River is the East Powerhouse which has room for nine more of the world's mightiest 108,000-kw generators. The first three will be installed next year. Already double the generating capacity of any power plant in the Pacific Northwest, Grand Coulee is fast becoming the greatest concentration of power generation in the world.—Photographs and information, courtesy of U.S. Bureau of Reclamation.



GLEAMING SHAFT OF STEEL (above) in West Powerhouse connects world's largest waterwheel with world's largest generator. Spinning at 120 rpm, nearly 4-ft-dia shaft is 74 ft long and weighs 200 tons.

NINE GOLIATHS of hydroelectric power now in operation in West Powerhouse at Grand Coulee Dam (left) serve critical needs of Pacific Northwest for energy for its farms, homes and industry. Hydroelectric power capacity of this powerhouse is energy equivalent of nearly 20 million barrels of oil per year.

CAPPING OF L-9 with identification number (right) marks start of production from ninth 108,000-kw generator. New unit boosts generating capacity of West Powerhouse to about twice that of any other power plant in Pacific Northwest.



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DEVELOPMENT OF HIGHWAYS to meet needs of modern traffic requires close coordination of those responsible for research and construction. Based on many factors which determine adequacy of design, highways must anticipate trends which are likely to develop in character of motor transport. Dual highway pictured here is Merritt Parkway, Connecticut. Photo courtesy Public Roads Administration.

Accelerated Highway Program Calls for New Design and Construction Techniques

Annual Report of ASCE Highway Division Committee on Developments in Highway Engineering and Construction Stresses Importance of Planning, Research, Design and Construction in Providing Modern Highway Systems

DAY OKES, Assoc. M. ASCE,
Chairman
Okes Construction Co., St. Paul, Minn.

THERE CAN BE little question as to the needs for highway construction now and in the future. The war period, while effecting a reduction in the number of motor vehicles using the highways, has resulted in a deterioration of the physical system due to lack of proper maintenance and replacement construction. The work to be done to take care of deferred maintenance alone is enormous. Although the number of motor vehicles is now approximately the same as before the war, the total number of vehicle miles has greatly increased. By 1960 it is estimated that there will be at least one-third more vehicles than now and perhaps double the vehicle miles of usage as compared with prewar. Undoubtedly developments in greater economy of operation of motor vehicles will offset restricted use due to present high production costs. A review is presented here of the planning, research and design studies that are necessary to assure economical, modern structures capable of meeting these modern highway traffic demands. The important role played by construction equipment and methods and the need for construction education are also discussed.

FULL COOPERATION between those engaged in research and construction is necessary if the greatest value is to be secured from highway construction. The type of design must be based on traffic requirements, which of course will vary from that of the most elemental land-service road or residential street carrying a few vehicles per day, to the complicated expressway carrying thousands. Research has shown that greater use can be made of native soils for highway purposes by stabilization and compaction.

Longer life of concrete pavements can be secured by improvements in design, the way for which has been pointed out by engineering research. Equipment manufacturers have not been slow in developing machinery to economically achieve these results. Construction contractors, alwaysalert to effect savings in operations, have served as a stimulus to both engineering research and equipment manufacturers.

Engineers are well aware of the Highway Planning Surveys and the excellent contribution which they have made in collecting information on all phases of the highway program. The principal need in this field is for methods of converting the information from surveys into concrete plans for programming future improvements. The Highway Planning Surveys have been carried on jointly by state highway departments and the Public Roads Administration under the terms of the Federal Highway Act since 1937.

Major accomplishments resulting from these surveys have included the preparation of road inventory maps and diagrams; complete analyses of highway traffic; the study of auto trip lengths and the exploration of traffic volume variations; careful investigation into the demand on highway systems made by urban and rural users; and detailed compilations of public finance. In addition to these were the studies of apportionment of road-user taxes, of highway costs, and of vehicle movements.

In 1944, an amendment to the Federal Aid Highway Act expanded the activity of the planning surveys. State legislative bodies recently have placed a burden on the planning surveys as information is sought on which to base the programs so essential to restore and advance highway systems.

THE FIELD of engineering was broken down by the Committee on Developments in Highway Engineering and Construction into three phases—planning, research, and design. This report considers each phase separately and attempts to show what is being done in each and what needs further emphasis. The material in the section on planning —taken largely from a paper given by G. Donald Kennedy, M. ASCE, at the 27th Annual Meeting of the Highway Research Board—reviews the developments in planning over the past few years and points to the immediate needs in this phase of the problem. Acknowledgment is also due to R. W. Crum, M. ASCE, Director of the Highway Research Board, and to other authors of papers given at the 27th Annual Meeting of the Board for material used in the section on research, and to Clayton E. Swain, Division Engineer of Division Two of the Public Roads Administration, for his ideas concerning developments in design.

MODERN EQUIPMENT makes fast work of loading. Here Caterpillar elevating grader on 4,800,000-cu yd earthmoving job near Tracy, Calif., loads W10 wagon drawn by diesel DW-10 rubber-tired tractor. Six-million-dollar contract calls for completion in period of 960 days.

LOADING OF SCARIFIED PAVEMENT into trucks on street widening project in Topeka, Kans. (above) is speeded by use of D6 tractor equipped with Traxcavator. Same equipment handles sand, bricks, concrete, and railway ties on this job.

WORKING IN EXTREMELY ROCKY SOIL, Lorain Shovel (above) loads hauling units consisting of Athey PD10 Trailer and DW10 tractor. Each unit makes three trips per hour on 1.4-mile round-trip haul. Job is relocation of U.S. 4, northeast of Rutland, Vt.

TREND IN CONSTRUCTION EQUIPMENT is toward more efficient, higher-capacity, faster and more powerful units within practical limit for weight capacity. Heavy equipment is pictured here constructing 7 miles of four-lane highway near Red Bluff, Calif.

RUBBER-TIRED TRACTOR (above) when not moving earth pulls wobble-wheel roller on relocation of U.S. 99 near Azalea, Ore. Three-tooth ripper (below) works on 4.2-mile stretch of road to summit of Los Padres National Forest, Monterey County, Calif.

CONSTRUCTION TECHNIQUE and the development of construction equipment go hand in hand. As construction procedure demands new and better tools and equipment, the manufacturers produce them. As manufacturers come out with improved machines, the construction industry takes them in its stride, utilizing them to full advantage, changing techniques and performances to get the most out of the equipment. Better construction equipment means better and lower-cost construction, but only if contractors are permitted to take full advantage of the potential performance of improved equipment. Designers, specification writers, project engineers, and inspectors all share the responsibility with the contractor of producing the best and cheapest construction possible from the available equipment.

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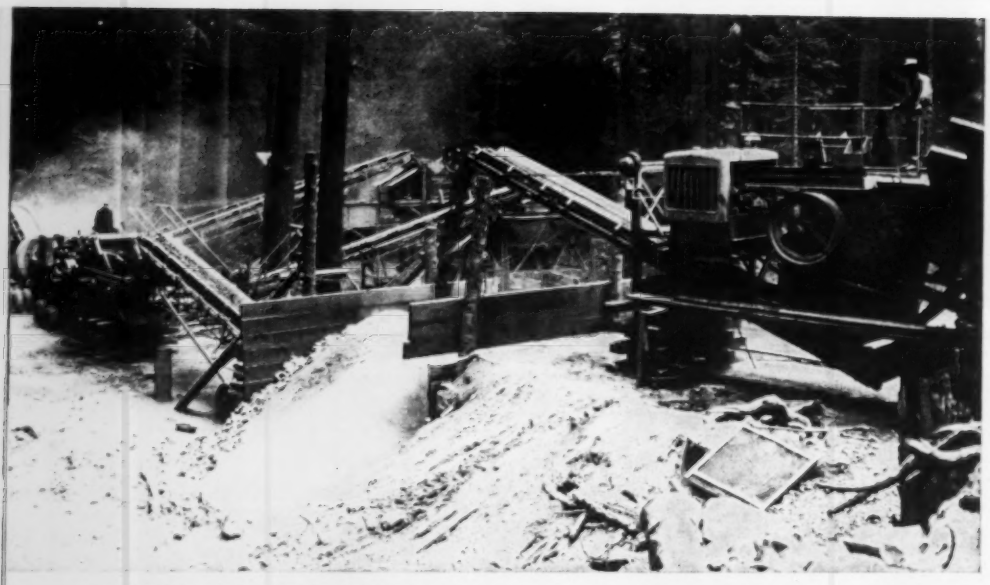


PORTABLE AGGREGATE PLANTS working roadside pits are replacing larger stationary plants. Iowa Manufacturing Co. equipment pictured here consists of four basic units which can be used separately or in any combination depending on finished product desired and pit or quarry available.

With administrators and legislators alike now seeking the immediate establishment of sound road programs, the ultimate objective of the surveys becomes immediate and calls for reporting of the first rank.

The impact of motor transportation on the states' future economy and any important changes in the character of motor transport likely to be developed by vehicles or drivers must be studied. To do this, important indices based on trends already fairly apparent must be projected into the future.

Studies must include the nature of road use, traffic pattern variations, travel origin and destination, speed problems, the kinds of vehicles in use, and other elements of traffic and human behavior. Roads must be classified according to a pattern of use and jurisdiction.

In order to secure the most economical and effective maintenance and the most efficient traffic control, standards for highway operation as well as construction must be accepted and expanded to include city streets and country roads.

From facts thus harvested, a program of needs can be prepared including cost estimates determined for a given number of years. A preliminary questionnaire was sent to the various states through the offices of the Highway Research Board to determine whether or not such activity was contemplated. On the basis of information derived from this questionnaire, a second and more extensive set of questions was sent to states which indicated plans for long-range studies. These well-answered inquiries and other records, including many state planning reports, were examined.

There appears to be developing a new high degree of interest and enthusiasm as states step up the tempo of their search for a solution to the long-range highway problem. Technical standards of surveys may vary in the different states, but a new awareness of the importance of finding an answer to the problem is everywhere apparent.

Research Needs Evaluated

Developments in research naturally follow the trends in the need for research. Perhaps the greatest need for new ideas and techniques at the present time is in the field of engineering economics. Widespread concern over rising costs of construction and maintenance of highways is apparent and rising costs of buying, operating, and maintaining motor vehicles have placed motorists in a position where they can little afford additional charges or taxes to help finance roads. It is obvious that a better system or more efficient use of existing systems of highway financing is needed.

Pressure is being felt in state legislatures for additional user taxes; nine states have gone to the extreme of road tolls to help augment inadequate highway income. Property taxes which in 1921 financed 70 percent of local roads now pay for less than 30 percent. Research is needed upon which to base equitable taxes so as to divide the burden among the owners of the property directly served; the general public; and the vehicle users, on the basis of the actual value of the highway service to each. User tax requirements which are consistent in the various states and uniform motor vehicle laws, as well as reciprocity between states, would help.

The Committee on Economics of Motor Vehicle Size and Weight of the Highway Research Board will undertake an exhaustive investigation de-

BAD DRAINAGE AND OVERLOADING are factors in pavement failures (above, left). Pumping of concrete pavements is result of deflections of slabs at joints, cracks and along pavement edges under heavy loads when subgrade has become saturated. Weight station (above, right) on Ohio Route 31 makes use of portable scales to check axle loads of trucks and buses.

signed to establish the ultimate economy of truck transportation, considering both the cost of operation of heavy vehicles and the cost of providing the roads necessary to accommodate them.

Highway administrators and engineers more and more are being required to consider urban highway development. A simple gridwork of city streets is no longer adequate. Express highways with right-of-way costs as high as 300 percent of the cost of construction; displacement of large segments of population with their necessary rehousing; drainage of long-depressed sections of expressway—these and many similar problems are new to highway engineers, and researchers are trying to help solve them. The matter of administration of highways also needs investigation.

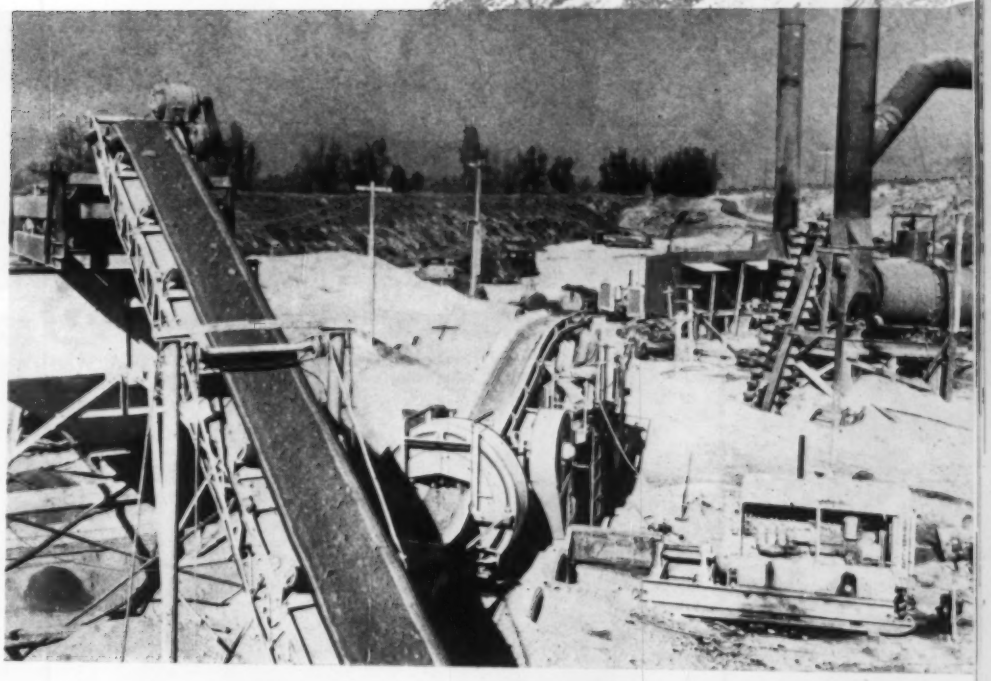
The other principal developments and needs for highway research at the present time can mostly be tied in one way or another to soils and highway foundations. Pumping of concrete pavements, a relatively new problem, although caused by frequent heavy loads, is essentially a foundation problem. Pumping is the result of deflections of slabs at joints, cracks, and along pavement edges under heavy loads after the accumulation of water in certain subgrade soils, and the subsequent ejection or "pumping-out" of water that carries soil in suspension. Such action causes cavities and soft spots under the pavement and eventual breakage of the slab due to uneven subgrade support. That this is a serious problem is attested by recent studies which showed that 60 miles of new pumping pavement per year are developing in Indiana alone whereas only 30 miles per year are being reconstructed or repaired. The ultimate solution to the problem lies in the foundation.

Basic Research Needed

Flexible pavement thickness has received much attention in recent years. While much has been done in establishing empirical thickness design methods, a more thorough understanding of the foundation material is needed. All this leads to a major premise concerning research. Soil mechanics has been through necessity a science based on practical considerations. Temporary answers to immediate soils problems have been provided. What is now needed is basic research into the fundamental properties of soils.

Relatively recent work has carried mapping and surveying far beyond simple highway location. Highway engineers are vitally interested in new techniques, based largely on air photos, by which soil patterns, and to some extent soil characteristics, may be accurately interpreted. Geologic and seismologic techniques add further to the tools for developing data on soils for engineering purposes. Basic research on the engineering properties of soils coupled with further development of mapping techniques will eventually result in filling the need for a comprehensive soils classification system.

Illinois and New Jersey have research projects under way which will consider the effect of eliminating transverse and longitudinal joints from concrete pavement. In the test pavements, transverse steel is continuous across the full width of the pavement, and longitudinal rail steel bars varying in quantity from 0.3 to 1.0 percent of the pavement cross-sectional area are used. In the first few months, the pavements have developed numerous transverse cracks which are held tightly closed by the steel. The morning after the curing paper was removed from the Illinois project, the longitudinal bars developed stresses as high as 30,000 psi. It is hoped that continuous reinforcement will do much to eliminate pumping, high joints, corner breaks, faulting joints, and blowups from concrete pavements.



BELT CONVEYORS (above) play important part in materials handling at asphalt paving plant, Bloomington, Calif. Material is trucked from sand pit to Cedar Rapids crusher from which it is fed to hot plant by conveyor belt. Caterpillar D4 tractor equipped with McCaffrey tractor shovel (right) keeps sand and gravel piles in order for rock-crushing plant. Standard Steel hot-mix plant is seen in background.

Through research, the practicability of using polarized light to provide greatly improved headlighting systems for automobiles has been demonstrated. The only remaining problems relate to methods of introducing the system, proper public education, and the development of interest among automobile manufacturers.

Design Closely Related to Research

Developments in design are largely dependent upon developments in research. On the other hand research is generally instigated to fulfill the needs of designers. The two fields are therefore so closely related that it is difficult to separate them. Since many phases of design have already been discussed, only the rather broad interpretation of the trends in highway design are treated here.

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CONSTRUCTION EQUIPMENT proved capable of handling accelerated military program in all theaters of war, but development of new models and improved machines was delayed during those years. Views show equipment used by Aviation Engineers in preparing air bases on Saipan Island in the Marianas (above) and at Myitkyina in Burma (below). U.S. Army Air Forces photos.

Structural design of pavements and highway structures has been developed and refined to the point where pavements can be designed to meet practically any given conditions. The only serious unknowns in structural design relate to foundations and to some extent to drainage. Thickness of flexible or rigid pavements required for certain loads over certain subgrades is still a matter of controversy.

Drainage researchers now consider the peak rainfall and frequency of storms as more important than the total quantity of water, and designs are being changed accordingly. These gaps, as has been pointed out previously, can be satisfactorily filled only through research into the fundamental characteristics of soils and water movement. In the meantime designers will continue to make excellent use of empirical formulas based largely on indicator tests.

There is always a lag between the development of a sound principle and its ultimate acceptance and use. Such a lag is apparent to a surprisingly great degree in the field of highway design. Authorities have agreed, for example, that simple preliminary soil tests are not only helpful but practically essential to those charged with building secondary roads, yet a great many state and county engineers still make no attempt to use them. The desirability of shoulders wide and firm enough to accommodate disabled vehicles is obvious, yet narrow shoulders are still being designed. Ohio is one of the very few states which recognize the value of turf on all slopes and the economic advantage of including turf as a part of initial construction. It seems obvious that turfing after construction is completed and erosion has already started must be more expensive, yet this practice is common. Thus it appears that one of the greatest "gaps" in the field of highway design is a matter of education of those doing the actual designing to insure that they will make use of what is already known.

Perhaps the most significant trend among designers is their increasing awareness of the need for consideration of external factors relating to highway use. The planning survey data, origin and destination surveys, parking studies, time and delay studies, and other similar sources of information are now being used by farsighted designers to provide highways of the proper capacity in the proper location to serve the greatest number of highway users at the lowest possible cost to taxpayers. Of course these aims are not always realized; more basic research and improved methods for conducting the various surveys and interpreting their results and continuing efforts to educate designers as to new developments are always needed.

Construction Equipment and Methods

The war proved construction equipment. Very little special equipment was developed, or needed, to carry out the speeded-up military program in this country or to carry construction operations into the battle zones. Few new ideas in equipment came out of the war. Yet the war did delay normal and routine improvements. Fast production schedules froze designs. Equipment engineers were busy elsewhere. After the war the pent-up demand for construction machinery and material and production shortages further delayed improvements.

A few developments have seeped through, enough to indicate trends. Also, by now, manufacturers are getting in shape to produce new models, new and improved machines. Ideas long shelved are now reaching the production line. Some new equipment is already available, but most of it will be displayed for the first time at the forthcoming Road Show of the American Road Builders' Association to be held next July 16–24 at Soldier Field, Chicago. A million square feet of exhibit space will display the latest in all types of construction equipment. By the middle of this year firms will be producing their new lines, so the 1949 construction season will blossom out with an array of equipment making current operations and procedures outdated, if not obsolete.

General trends in construction equipment are toward more efficient, higher capacity, faster and more powerful units; however research has shown that in certain soils there is a practical limit to the weight capacity of earthmoving equipment which should not be exceeded. More precise control and greater safety are being built into machines. There is a tendency toward automatic control devices in the preparation and mixing of construction materials, including increases in accuracy.

Small tools and auxiliary equipment are getting a big play today because of the cost of labor. Tool skill is replacing human skill wherever possible. Earthmoving equipment is also receiving special attention. Two-wheel, high-speed tractors are becoming more and more common, reaching a high degree of development. New compaction devices are appearing, such as a heavy vibrating roller and 100- and 200-ton pneumatic tire rollers. A high-capacity elevating grader is an indication of the trend in high-speed loaders, which fill wagons, hauled by high-speed tractors, in a few seconds.

Efficient portable aggregate plants that produce suitable material from roadside pits are replacing the larger stationary plants—a trend influenced by constantly increasing freight rates on bulk materials. Belt conveyors are playing an important part in materials transportation; their full possibilities have not yet been realized.

These are but a few examples of current equipment trends. The entire construction industry, from planning and design down through engineering direction and inspection and into field construction operations, must be fully aware of these changes and improvements if construction technique is to be allowed to develop. These trends are the answer to increasingly higher costs in construction. Only through improvements in equipment, with corresponding improvement in construction operations, can costs be kept within economical limits that make construction possible.

Technical magazines are the best sources of information concerning equipment and operation trends, for they faithfully report advances in the art of construction. Manufacturers are becoming aware of the need for carefully prepared manuals on the operation, care, and maintenance of equipment, as well as for better sales manuals and sales promotion courses. The more widespread education about construction equipment becomes, the more effectively will the machines be used, resulting in better and cheaper construction.

The construction industry has grown until it has become a very important part of our national economy from the standpoint of both dollar value and public facilities involved. Reduction in cost would mean more facilities for the public, a larger market for the manufacturer and distributor of materials and equipment, and more employment for the engineer and the skilled and semi-skilled worker.

Construction Education

In the past year or so, great interest has been aroused in construction education. About 48 engineering schools and colleges in this country now offer some kind of a course in construction. These courses vary widely in effectiveness and scope. Some are old courses; many are brand new.

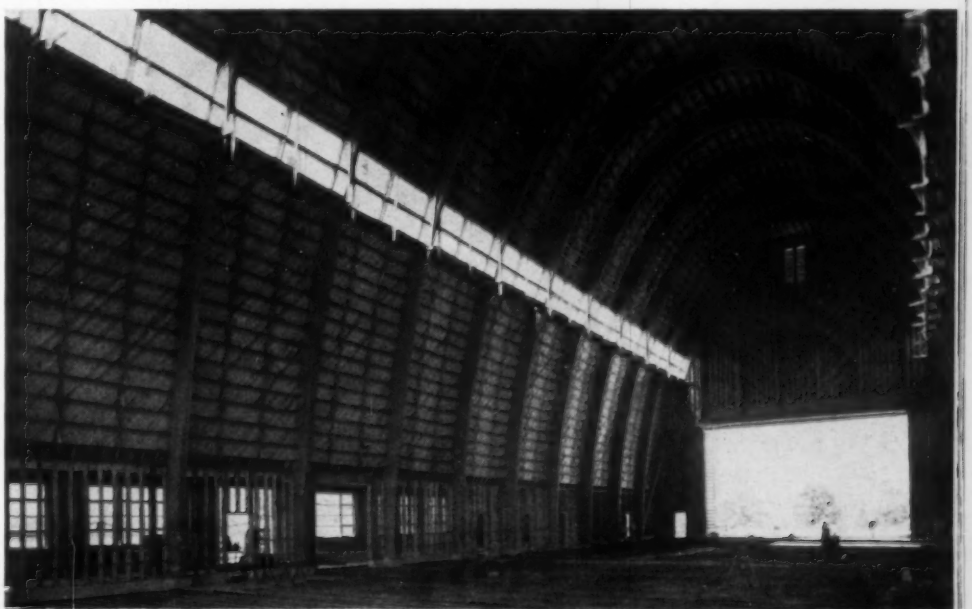
The construction industry believes that engineering schools should offer some basic and background training to those students interested in construction as a career. Just what should be taught, how much and in how great detail, are still questions to be fully decided. Each school has its own ideas, and probably never will the technical teaching profession fully agree on the details of a construction curriculum. Yet considerable progress is being made.

The greatest handicap to establishing construction courses is lack of teaching material. Textbooks, visual-aid material, films, manuals, and lecturers are badly needed. Some of this material is already available in the offices of equipment manufacturers, in contractors' files, and in association archives—but just how much, in what form, and how available, are matters yet to be learned. The colleges, especially those just now establishing construction courses, are not yet too certain as to exactly what they need and want. Several years of teaching experience will be necessary before we have all the answers.

Several committees in the ASCE, ARBA, ASEE, and AGC are concerned with construction education. Work of these committees overlaps, and committee personnel is often duplicated. One big need, it seems, is a coordination of all these efforts under a steering committee for most effective results. The ASCE might well take the lead in this effort.

High Laminated Timber Arches Provide Large Unobstructed Space for Radar Laboratory

HANGAR-LIKE LABORATORY at Wright Field, Dayton, Ohio, with 75-ft ceiling height and 15,000 sq ft of uninterrupted floor area has ample space for testing of radar equipment by Army Air Forces. Because of its height, laminated timber arch structure, designed by Corps of Engineers, is especially well adapted to use of radiant heating, which gives small temperature differential between floor and ceiling—frequently as low as 1 or 2 deg. Heat output needed to meet design temperature, on basis of standard requirements, is 935,000 Btu per hour. Coils of wrought-iron pipe ranging in size from 1¼ to 6 in. are embedded in or under concrete floor slab and supplied with water at 140 deg F from heat exchanger, which in turn is fed with steam from Wright Field power plant half mile away.



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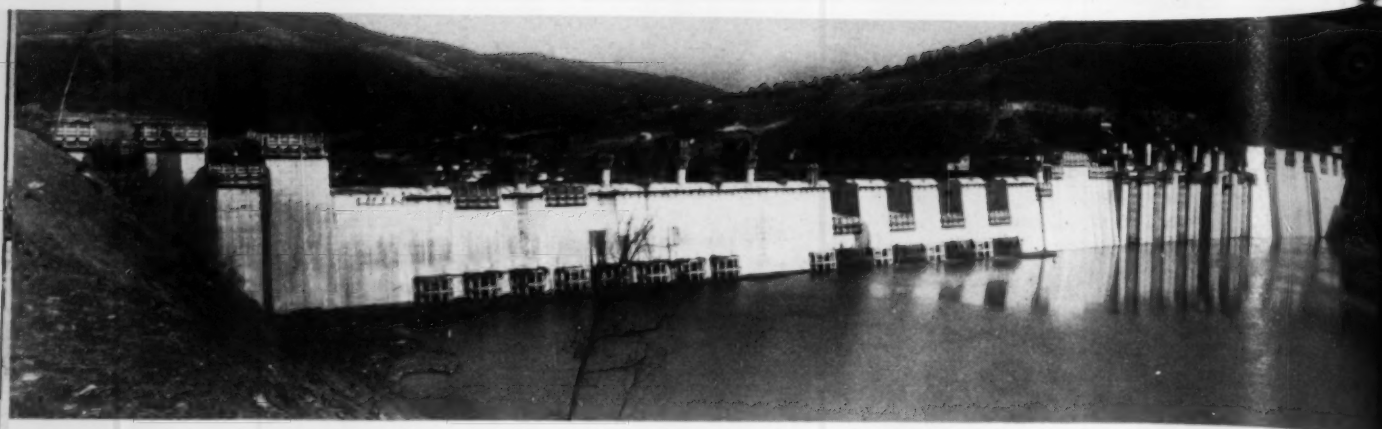


BLUESTONE DAM, constructed primarily to avert repetition of destruction wrought by flash floods in vicinity of Charleston, W.Va., is shown here in final stage of completion. View is from upstream side of dam looking north. East abutment (right) is already topped out. Four diversion monoliths at center of dam are two-thirds complete.

Economy in Materials Handling Features Bluestone Dam Construction

Concrete Gravity-Type Structure Will Check Destructive Flash Floods Originating on New River Watershed in West Virginia

ORVAL AUHL

General Superintendent, Contracting Division,
Dravo Corporation, Pittsburgh, Pa.

NOW NEARING COMPLETION, Bluestone Dam, a 200-ft-high power and flood-control structure on the New River in West Virginia, was planned as early as 1936, but was not actually begun until after the flash flood of 1940. On August 16 of that year a cloudburst on the New River watershed sent a disastrous surge of water racing down the stream, flooding and blocking highways and sweeping houses and buildings, farm crops and valuable top soil before it. Just above Charleston, W.Va., a 15-mph current caused by the 232,000-cfs flood swept the river clear of all boats, coal and material barges and floating equipment, sinking, wrecking or beaching half of the 50 or more craft torn from their moorings. For many years private interests attempted to remove this flood menace but did not muster sufficient funds to build a dam. Details of constructing the 950,000-cu yd concrete dam presented here are from a paper presented before the Construction Division at the ASCE Pittsburgh Meeting.

THROUGHOUT its entire course, the New River flows through rugged mountainous country. Its valley is narrow, and the flood plain is little wider than the river channel, which varies from 500 to 1,000 ft in width. The grade of the river bed is very steep, and has an average slope of 9 ft per mile for its entire 340-mile length. Bluestone Dam is in the section having the flattest slope—4 ft per mile.

The sandstone and shale formation for a distance of approximately 40 miles upstream from the damsite is horizontal, while beyond and in adjacent country the rock generally stands on end. In recent years it was discovered that more water flows in the New River at Radford, Va., 60 miles above Hinton, than at the damsite itself. Government agencies are trying to locate the place of loss, and direction of flow, into some subterranean stream.

Recorded mean annual rainfall over the New River watershed above Hinton for a period of 54 years is 40 in.

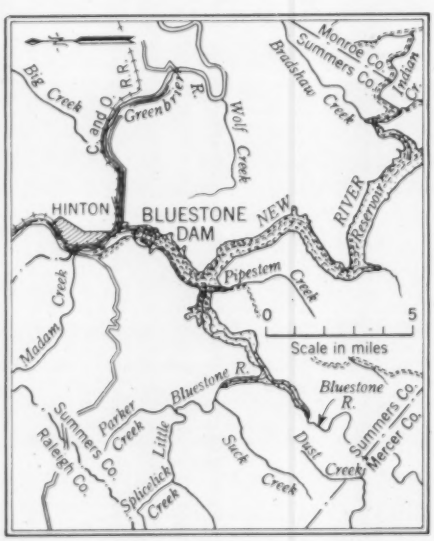
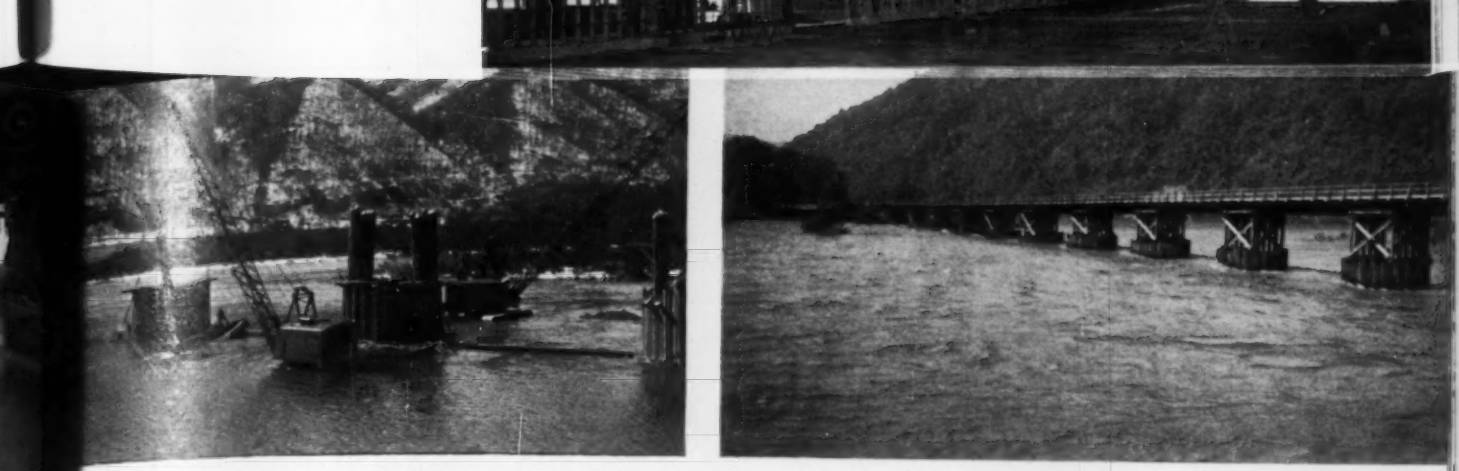


FIG. 1. LOCATION MAP shows Bluestone Dam near Hinton, W.Va., on New River just below its confluence with Bluestone River and above mouth of Greenbrier.

The mean annual rainfall varied from 27 in. in 1930, to 52 in. in 1901. The rainfall is heaviest in the upper part of the basin, which has had some of the greatest precipitation on record in the country. In 1916 it is recorded that 23 in. of rain fell in 24 hours at Alto Pass, N.C.

The average daily discharge at Bluestone Dam is 6,000 cfs. The normal low-water flow is 2,000 cfs although the maximum, recorded in 1901, exceeded 280,000 cfs. Had the 1916 record rainfall recorded at Mt. Alto fallen on the upper region of the New River watershed, the discharge at Hinton would have exceeded 360,000 cfs. These data were used in determining the height of the dam. By holding back 360,000 cfs of water at Hinton, private as well as government agencies have calculated that 15 ft of flood water can be held off of Charleston, W.Va., the chemical center of the "American Ruhr Valley."

The lower 25 miles of the Bluestone Reservoir is unusually free from utilities and natural growth. There are no railroads or well-improved highways, a comparatively small amount of agricultural land, no minerals or natural resources and very little usable timber. In the upper region, above the reservoir, however, there are two first-class railroads, a steam power plant, a textile mill, and a num-



EMPORARY RAILROAD BRIDGE 1,040 ft long, across mouth of shallow Greenbrier River, is constructed by crawler cranes traveling on iver bed (above, left). Piers consist of steel sheetpile cells enclosing 12 wood piles driven to refusal. Cells are filled with sand and gravel nd capped with 9 in. of concrete. Braced and capped wood piles support special rolled 36-in. 350-lb I-beams (above, right) which provide 5-ft span between piers.

OX-TYPE COFFER of hard wood on down-iver arm of main cofferdam (at right in hoto) is used during wartime steel sheet-ile scarcity. Main cofferdam enclosing 16 cres forces river into 300-ft channel on left ank. Cells of conventional design, 26 ft igh, are used for upper arm.

ber of bridges and towns. These improvements, situated 36 to 40 miles above the dam, limited the height for power.

Building of two miles of single-track railroad and a railroad bridge 1,040 ft long across the mouth of the Greenbrier River was the first problem confronting the contractor on the Bluestone Dam Project. The Greenbrier River, normally a few hundred feet wide, broadens out to 1,040 ft where it empties into the New River, thus reducing its depth to a 4-ft maximum in the low-water season. The contractor took advantage of this condition to use crawler cranes, traveling on the river bed, for building the bridge.

The piers and perhaps the bridge itself are unique in design. The 16 piers were constructed by making an island of river-dug sand and gravel, leveled off a few feet above the water. A 20-ft-dia template was accurately set; then steel sheetpiles 16-ft in length were spun around its periphery and driven to rock. The entire bridge was built, ready for trains, in 45 days, but it could have been completed in less than 30 days had all materials been readily available. Quantities required were 200 tons of sheet piles, 8,000 ft of wood piles, 400 tons of steel and 140,000 fbm of timber.

When the contractor moved in, he found a flourishing cornfield, broom factory, and dairy farm, all of which were soon transformed into a beehive of construction activity. Even before the railroad bridge was completed, crawler equipment was forded across the Greenbrier River and up the New River to the site of the work. An 80 D Northwest crane with 2-cu yd dragline bucket was used to load 11-cu yd Athey wagons, pulled by TD 18 tractors from the earth cut.

The excavated material was used to build up the storage yard and railroad fills at the damsite. The fill varied from 5 to 20 ft deep by 100 ft wide for the entire 2,000-ft length of the railroad yard which parallels the river just below the dam. A 5-ft layer of crushed shale and sandstone from the rock excavation was laid on top of the earthfill and dressed down by bulldozer. A total of 5 miles of standard-gage track was built in the conventional manner by leaving the fill a little low, laying the ties and rail, then blocking up to grade and filling between and under the ties with sand, gravel, and cinder ballast.

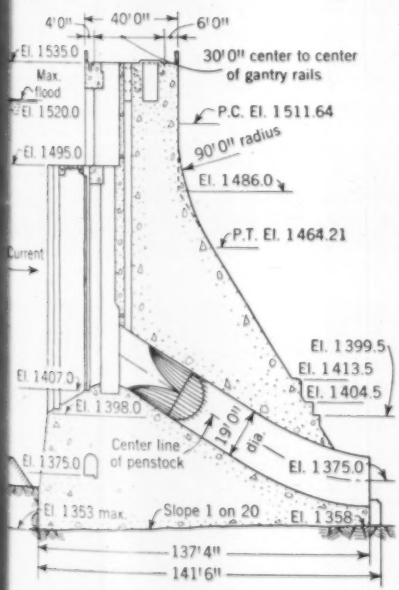


FIG. 2. INTAKE SECTION of dam shows 18-ft-dia penstock and final location of gantry tracks used in construction. Dam will have head of 150 ft and reservoir capacity of 622,800 acre-ft at maximum flood crest of 1,520 ft.

Steel Sheetpile Cutoff Wall

Before building the main cofferdam, it was necessary to drive a row of arch web steel sheetpiles starting at the river and extending back to the high ground; M115 piles 25 ft long were driven to rock leaving 10 to 12 ft exposed above the ground. The purpose of this wall was to prevent the river from cutting behind the main cofferdam during a flood and washing away the yard and construction facilities.

Earth taken from the common excavation was used to fill above the wall, and rock from the cut was placed as riprap on the downstream side to

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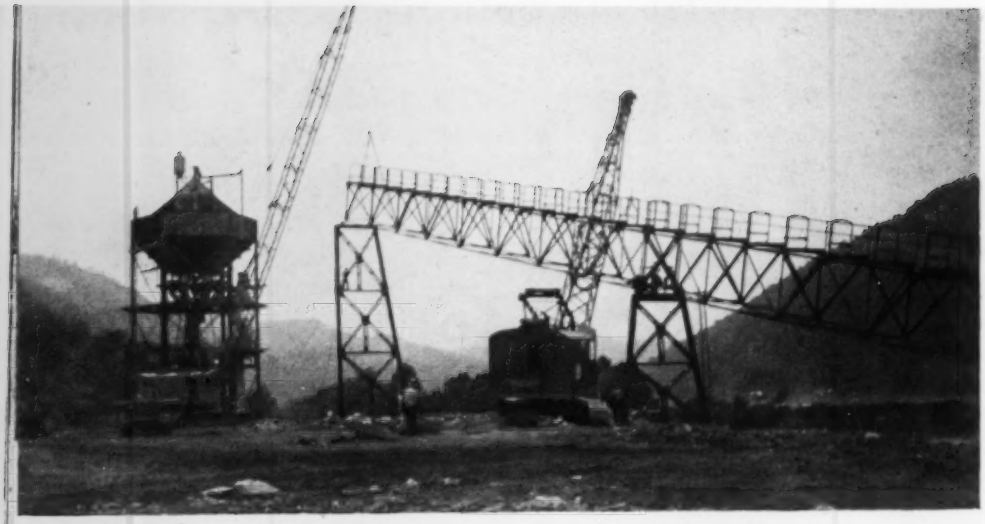


TRUSS FOR 125-FT SECTION OF BELT CONVEYOR from aggregate hopper to mixing plant is erected by Northwest Crane with 110-ft boom. Crane is also used in handling and erecting steel superstructure of plant. Six 14-in. columns of plant support total load of 1,200 tons. Bins hold 750 tons of aggregate and two carloads of cement. Aggregate is spilled into proper bin by pivoted distributor located immediately under end of top conveyor. Mixer foundation in center of plant is built independent of bins which support weighing equipment to prevent mixer vibration from affecting scales.

prevent scour. Fortunately, the river never topped the cutoff wall. A temporary earth dike along the river side held the water out while sufficient rock was drilled and shot to make the riprap. On completion of the cutoff wall, the building of the upper arm of the main cofferdam was resumed.

Before work was commenced in the second cofferdam, the water was made to flow through four diversion monoliths of the main dam and a continuous gap in the weir.

Building the Main Cofferdam

The contract for the work was let shortly after the United States entered the war. High priorities on steel at that time immediately spiked any idea that new sheetpiling could be purchased; hence the contractor was obliged to use his limited stock to the best advantage. The down-river arm of the main cofferdam was built of hard wood. Mild steel rods held the side walls plumb while the earth and rock fill was being placed. Where possible, berms were placed on the outside for additional stability. This type of cofferdam was used principally in building locks and dams on the Ohio River before steel sheetpiles came into extensive use, and is known as the Ohio River box cofferdam. The river was forced into a 300-ft channel on the left bank and the main cofferdam, enclosing 16 acres, was built high enough to withstand an average flood.

Cells of conventional design, 26 ft high, were used for the upper arm of the first cofferdam. The river arm, 600 ft long, varied in height from 26 ft at the upper end to 14 ft at the down-river end. It was necessary to build the upper arm of the second cofferdam 40 ft high to cause the river to flow through the four 55-ft gaps in the dam. In cellular cofferdams, interlock tension is of utmost importance; hence it was necessary to check the thumb, finger, and groove of every sheet, making certain that they did not exceed the tolerance allowed.

In building a cell it is essential to set and drive the Y-pile first. If this is done accurately the intermediate sheets will drop into proper place without danger of leaning or spiraling. It is of course necessary to exercise care in filling the cells; they must be filled from the center outward. For convenience and speed, all piles were prepared at the yard and delivered at the place of erection in exact lengths.

It was necessary to use every piece of pile regardless of length. Short pieces were spliced into double sets and individual lengths were tied together with bolted splice plates. Only full-length single sheets were used on the river side of the cell, but for the cross walls and inside walls, spliced sheets could be used. Additional holes were burned in the inside sheets to facilitate drainage. This type of cofferdam has been used successfully since 1928. At Kentucky Dam on the Tennessee River sheetpiles 100 ft long were used, and work progressed inside the cofferdam while flood waters were a few feet from the top.

Drilling 30-In. Core Holes

Army engineers made an extensive investigation of the rock foundation by core drilling 74 test holes varying from 2 to 30 in. in diameter. The 30-in. holes were drilled to permit geologists to descend to a maximum depth of 75 ft and obtain a true picture of the rock formation and conditions. The dam rests on hard, fine-grained laminated sandstone and sandy shale 60 to 90 ft thick and at the abutments it ties into beds of shale, sandstone and impure beds of limestone. Eight additional 30-in. holes were drilled to determine the depth and extent of the fault which was known to lie near the east quarter point in a diagonal line across the axis of the dam.

A core barrel 6 ft long, with notches cut in the bottom rim for dragging the chilled shot, was lowered into the hole in stages and connected to the drill by large shafting. The hardness of the sandstone reduced the effective production to a maximum of 3 ft per shift. Usually an air-operated pump of 50-gpm capacity was sufficient to keep the water down while workmen descended into the core hole and fixed

POWERHOUSE AREA IS BLASTED by 3,000 lb of dynamite in one charge (below, left). Man in photo is standing 200 ft from rock blast. Wagon drills are moved in again (below, right) to drill another bench. Total of 250,000 cu yd of rock is broken up and hauled from cut by means of 11-cu-yd Athey wagons loaded by small shovel. Largest shot in main dam set off over 2½ tons of dynamite in 415 holes 14 ft deep. Largest shot in abutment consumed 4,250 lb of dynamite, bringing down about 8,000 cu yd of rock.

the eye-bolt into the sandstone core for hoisting to the surface. Any broken pieces were placed in a bucket and lifted out before drilling was resumed. Specimens of each core were carefully laid out on the ground in proper sequence for study by the geologist and engineer.

Three-Inch Diamond Core Drilling

The net result of the drilling of the 30-in. core holes was the decision to consolidate the rock under the entire structure by the stage pressure method. Diamond core holes, 60 ft deep, were drilled according to a pattern which covered the entire area, first on 40-ft centers, then on 20-ft centers, and finally on 10-ft centers. If the last set of holes proved wet they also were grouted. The stage method employs a packer fitted tightly into the hole 10 ft from the bottom. Creamy grout is pumped at a pressure equal to 1 lb for each vertical foot above the packer. After the desired pressure has been reached and the needle has not drifted back for a given time, the packer is moved up 10 ft and another band is grouted. This procedure is repeated until the hole is grouted to the top.

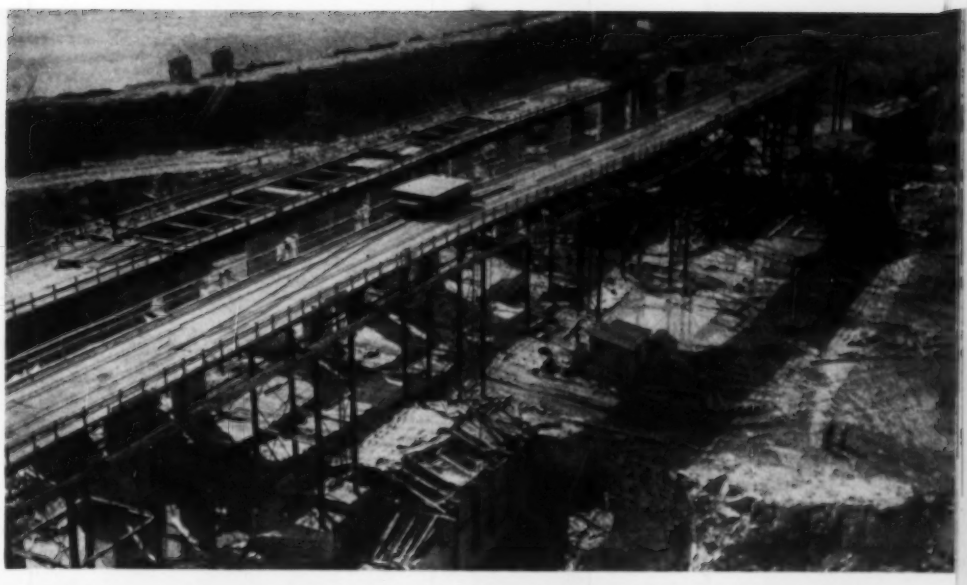
Eight hundred holes were grouted in this manner, averaging 155 bags per hole. Some holes would take no grout but one along a fault took over 4,000 bags. Close coordination was required to deliver the four carloads of cement to this particular hole.

The extensive rock excavation performed in following the fault was dubbed the "glory hole." This "hole" started out as a minor investigation in a small area at a relatively shallow depth, but ended in a major rock job going as deep as 40 ft below the river bed. Rock was removed, cleaned up, and inspected in nine successive steps. Fault lines were found near the surface and were followed down the slope until the fault pinched out in hard rock. At one place the fault crossed at 90 deg and had to be followed in the opposite direction. Men with picks and shovels could excavate the pulverized shale and sandstone band sometimes 24 in. in depth. Above and below this pulverized band the rock was very hard.

The drilling for shooting and line drilling was performed by X71 percussion drills mounted on a wagon drill carriage or broaching machine. Drilling for shooting in the main dam was generally limited to depths of 12 to 14 ft. Water was poured into the drill holes for reducing dust. The entire downstream edges of both the weir and main dam were line drilled on 6-in. centers to prevent overbreakage when shooting, and to preserve a solid face for the concrete to butt against. The hard, abrasive sandstone made it necessary to change bits every 3 ft of depth drilled, starting with 3 in. and stepping down $^1/_8$ in. for each change. Excellent results were obtained by shooting no closer than 20 ft from the drilled line. Subsequent shots were benched toward the center after the muck had been removed.

Before loading, every hole was blown out to its entire depth. Some blasters slit the dynamite cartridge before loading to assure proper spread and compaction as the dynamite was rammed into the hole.

Wooden poles were used to tamp the holes as tight as possible. After stemming the holes with sand, the leads were connected to a 220 a.c. circuit and detonated. The first charge set off involved 2,000 lb of dynamite and broke up nearly 4,000 cu yd of rock.



HIGH-LEVEL DINKEY TRACK is carried on job-fabricated trestle which is embedded in concrete as work progresses. Two loaded 2-cu yd concrete buckets are hauled on each car with space for empty bucket.

WHIRLERS FOR HANDLING materials and concrete for main dam are erected on 36-in. I-beam trestles supported on unreinforced 8-ft-dia concrete columns. Columns which become part of dam are located to miss openings and embedded items. Whirlers are moved up in five stages as concrete work progresses.

Removal of overburden and rock from the abutments usually presents a problem on a project of this type. An access road was cut up the mountain on the downstream side of the dam to permit a crawler crane with dragline attachments to reach up near the top and scrape the overburden from the rock. Wagon drills were pulled up the steep mountain side and held with block and falls fastened to trees higher up. The downstream limits of the cut were line drilled, full depth, from a ramp, built in place on the 45-percent slope.

After the first shot, the rock was brought down in benches 30 ft high. The depth of the bench was limited to the maximum length of drill steel that could be handled by the wagon drill on the steep slope. This vertical depth probably was most economical because it fitted well with the 50-ft horizontal distance back into the cut. The largest shot of the abutment consumed 4,250 lb of dynamite and

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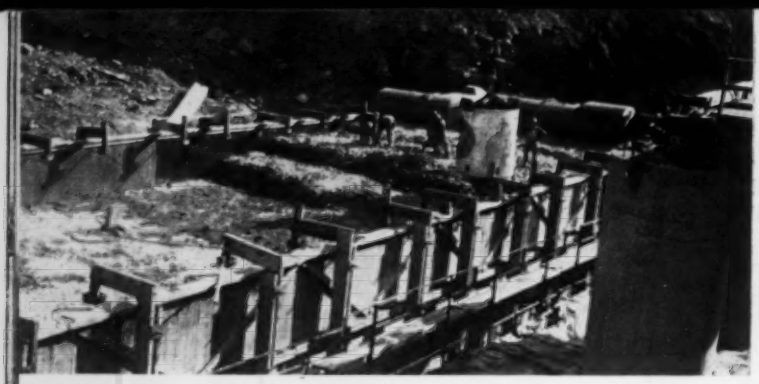
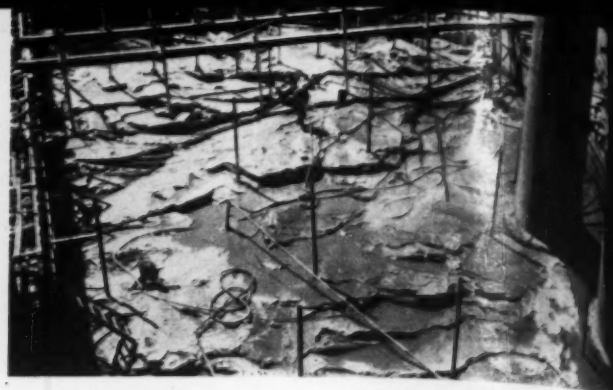


CONCRETE IS PLACED DRY as possible and then struck down and vibrated by two-man high-frequency Chicago Pneumatic vibrators, operating at 110 volts, 120 cycles and 8,000 rpm. Gates on 3-cu yd concrete hopper, now operated by air rams, eliminate old-fashioned backbreaking manual operation. Flip of short lever operates gate.



GREAT VOLUME OF WATER at 180-lb pressure is necessary to clean irregular bedding planes of fine-grained laminated sandstone and shaley rock foundation to ensure proper bonding of concrete monoliths. Being of sedimentary formation, rock displays semi-spheres, cups and even ripples.

brought down nearly 8,000 cu yd of rock. Delays were used to pull the sides before the center rock dropped.

Shooting Limestone for Aggregate

Aggregate for concrete was quarried and crushed at Snowflake, W.Va., 26 miles by rail from the dam, by General Crushed Stone Co. and the Acme Limestone Co. Churn-drilled holes 9 in. in diameter and 230 ft deep were loaded with 5-in. dynamite cartridges dropped from the top. Primachord lowered into the hole with the first cartridge set off the charge. The holes were drilled 20 ft back from the face on 30-ft centers. At the bottom, horizontal snake holes were loaded and shot at the same time to prevent a hump in the quarry floor near the face. Sixty tons of dynamite was used to bring down 240,000 tons of rock. This calcite limestone proved excellent material for concrete.

Stone was loaded into trucks and hauled to a 48×60-in. primary jaw crusher from which it traveled to the secondary crushers over a 48-in. belt. The plant was designed to produce the various sizes of stone—6 in., 3 in., $1\frac{1}{2}$ in. and $\frac{3}{4}$ in.—in the quantities required at the dam. Two hammer mills produced lime sand in the proportion of 15 percent of the total aggregate. The lime sand contained fines to the amount of 15 percent passing the 100-mesh screen, which blended well with the natural sand.

Every afternoon the C. & O. Railroad Co. sent a special train, dubbed "Gravel Gerty," to the quarry to pick up a string of cars loaded with aggregate. It is estimated that if the 50,000 cars which crossed the Greenbrier River bridge were made into one train it would extend from Pittsburgh to Chicago.

The aggregate hopper required 900 wood piles 25 ft long, which were driven at the rate of 58 per shift using a 9B3 double-acting hammer. The hopper was 40 ft wide by 444 ft long and required 270,000 fbm of lumber and a carload of nails. Very few bolts were used. The 222 trusses were made in a jig on a production-line basis, erected by crane, and held in place by 2-in. horizontal sheeting which lined the hopper. Partitions were built to separate the aggregate.

Aggregate consisted of crushed limestone from Snowflake and fine aggregate—made up of lime sand from Snowflake and natural sand from the Scioto River near Chillicothe, Ohio. Specifications required the blended sand to contain a minimum of 4 percent passing the 100-mesh sieve, but were changed later by agreement to a minimum of 8 percent passing the 100-mesh sieve. The material was fed by gravity and a Jeffery feeder onto a 30-in. belt located in the center, under the hopper. Over 1,500,000 tons of material passed through the hopper while the dam was under construction.

Only the 3- and 6-in. stone was laid on the 30-in. belt by Jeffery feeders; the rest of the aggregate, including sand, was fed by gravity gates. The lower belt extended on the level for a distance of 520 ft, then up a 7 percent slope 250 ft to a transfer intersection. The upper belt, traveling up a 24-percent slope, took the material away from the lower belt at the rate of 350 fpm. With full load, it is estimated that the 11-ton pull on the belt caused it to stretch as much as 24 in. An automatic take-up at the lower end kept the pulley in alignment. The belt had a capacity of 300 tons per hour.

Installing Mixers in Plant

Delivery of the three 3-cu yd Koehring mixers was delayed until after the mixing plant had been erected. The mixers were erected by nosing the boom of a crawler crane into the portal opening left for the purpose, and telegraphing* them into position with the charging throat toward the center. Each tilting mixer had a capacity of 60 cu yd per hour. The mixing plant was designed to handle, batch and mix 4,000 cu yd of concrete in 24 hours. After the three mixers were

* Term used to describe handling of plant beyond the reach of a crane by paying off on the holding line and taking up on another line holding the plant or equipment in the air until it is landed over the anchor bolts.

APRONS ARE ANCHORED by hook rods grouted into bedrock. Most footer forms are constructed of slabs, set, lined and braced to pins drilled into rock. Rock is thoroughly cleaned before placing form, to reduce inside cleaning to minimum.

n place, the mixing plant was completely closed in.

All the aggregate was elevated to the bins at the top of the mixing plant by the belt conveyor and was spilled into the proper bin by a pivoted distributor, located immediately under the end of the top conveyor. One man operated the entire mixing plant from the control panel. Three mixes could be set on the scales and the mix changed back and forth by merely moving a lever on the panel. All material was weighed. Specifications required that materials entering the mix be controlled within 1 percent by weight.

Tilting mixers held charging and discharging to an absolute minimum, assuring the inspector that the concrete was mixed at least the specified time without loss of production. At the end of a run, wash water was allowed to slush around a few minutes to clean the mixers. Two tons of hard surface metal was used to coat the wearing plates. At the end of 250,000 cu yd, the back sides were worn slightly. The affected surface was touched up and since then 620,000 cu yd of concrete has been mixed. It is believed that it may be necessary to go over the surface again at the finish when 900,000 cu yd will have been mixed.

Concrete was dropped from a hopper under the mixing plant into 3-cu yd bottom-dump concrete buckets and hauled to the forms by an 8-ton diesel dinkey. For safety in hauling 20-ton loads, the dinkey gage was increased to 42 in. and the rail size to 60 lb. Spring switches, properly set, eliminated brakemen. Dinkey loads traveled out on one track and back on the other through switches which sprang back automatically after the train had passed through.

A thin layer of grout was spread over the old concrete and thoroughly broomed in just ahead of each new pour. Three-bag concrete with 8-percent fines, and Darex, an air-entraining agent, produced dry but workable concrete. High-frequency vibrators consolidated the concrete and drove out air pockets. The Darex reduced bleeding. After the concrete had taken its initial set it was cut with water and air jets and washed off with water under high pressure. Care was taken to cut the concrete at the proper time so that only the thin film of laitance was removed.

Forms with inside support, known as Hiawassi, were used for the second lift of each monolith. These forms were more difficult to hold to exact line than the cantilever forms. Sufficient face forms were built to reach the entire length of the dam but only enough bulkhead or side forms for the lower half of two-thirds of the monoliths. The steel shortage made it necessary to resort to 14×16-in. Douglas fir timber for strong backs. Safety scaffolds were attached to each form.

Test cores, cut from the monoliths by a diamond-studded bar, showed that, for all practical purposes, the bonding of horizontal joints was perfect. Out of 120 cores 12 in. in diameter taken through the horizontal joints in a dozen monoliths, only one joint could be detected. Even when dropped the cores did not break squarely across the joint but irregularly through the stone.

Baffles, sometimes called "piano keys," anchored into the apron of the dam and heavily reinforced were designed to quiet the water as it pours through the sluices or spills over the crest of the dam. Forms for the baffles were lined with absorptive lining before the concrete was placed so as to produce a smooth exposed surface. The piano keys of the weir dam were built square and served the same purpose as the streamlined baffles. Piers for the temporary bridge below the dam were founded in rock.

To permit greater grout pressures to be used without danger of jacking the rock, in some sections of the dam 6-in. pipe was embedded in the concrete and carried up 30 ft. Holes were drilled through the pipe 60 ft into the rock and grouted.

Models Help Solve Britain's River Problems

SOLUTIONS TO PROBLEMS involving heavy silting of the approach channel to the Rosyth Dockyard on the Firth of Forth and shifting of the navigable channel on the River Wyre in Lancashire are being sought by the British at the National Physical Laboratory at Teddington, Middlesex. Scale models of these rivers have been built which include details of beds and channels. An ingenious mechanism permits all characteristics of the normal 12½-hour tide periods to be compressed to five minutes. The rise and fall of tide waters carries silt and re-forms channels precisely as the rivers themselves have done for thousands of years. Data obtained from day-to-day tests in the laboratory would take centuries of work with costly apparatus on the actual rivers.

The Hydraulic Research Organization in charge of the tests is confident that in twelve months it will have both problems solved, and will be able to demonstrate the exact shape and size of groins, walls, etc., which will end the difficulties now being experienced.

MODEL OF FIRTH OF FORTH at National Physical Laboratory, Teddington, England, provides data needed in correcting difficulties caused by heavy silting of approach channel. In view, looking east, Forth Bridge and Rosyth Dockyards are seen in middle-distance (at "V" indentation of model frame). Horizontal scale is 1:1,800 (approximately 3 ft to the mile) and vertical scale is 1:144 (½ in. to 6 ft). Scale distortion is helpful in obtaining useful measurements of depths and other vertical factors. Lines strung across river form grid for model. In background is mechanism which simulates tide action. Flow is controlled to give exact proportionate velocities of current relative to actual river.

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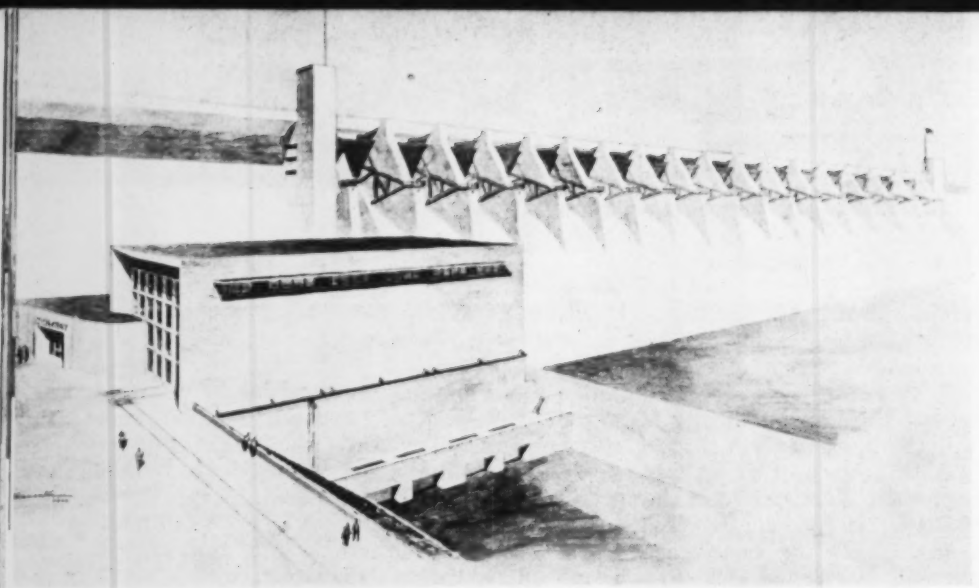

WHITNEY GRAVITY-SECTION DAM near Hillsboro, Tex., is most important unit of comprehensive river development, flood control and water conservation program for entire Brazos River Basin. Designed for U.S. Engineer Department by Ambursen Engineering Corp., powerhouse contains two Francis-type waterwheels of 20,700 hp each, driving 16,667-kva generators under 91.5-ft head. Concrete section of dam is 163 ft high and 1,674 ft long; total length with embankments is 9,925 ft. Congress-approved Belton Dam on Leon River near Temple is further step in Brazos River regulation, while Brazos River Conservation and Reclamation District soon will start De Cordova Bend, Inspiration Point and Turkey Creek Dams and powerhouses.

Federal Government Plays Important Role in Development of Hydroelectric Energy

HOMER B. PETTIT, M. ASCE

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NEED FOR A DEFINITE POLICY and program by the federal government in connection with the development and distribution of hydroelectric energy is indicated by the fact that there were six outstanding pieces of legislation introduced in the 80th Congress dealing with this subject. Presented here are the results of research on the legislative history of the United States over a period of more than 50 years and of studies of legislation now pending, pertaining to the generation, distribution, and sale of electricity. The facts recorded provide an insight into the part played by the federal government in the development of one of our great natural resources.

IN THE EARLY DAYS of the nation, the Colonies controlled their navigable waters. In effecting this control, they issued permits to construct dams, build bridges, construct wharves and divert waters. The Colonies in some instances built bridges, wharves, and dams and dredged channels. The part the federal government was to play in directing the uses of navigable waters of the United States was slow to develop. For many years after the Constitution was adopted, the states continued to make river and harbor improvements at their own expense.

Beginning in 1906, however, the tendency has been for the federal government to expand its control to such an extent that the question has arisen as to whether it is exercising powers that should, as a matter of policy, more properly be exercised by the states. In exercising its powers with respect to navigable waters, the federal government, notwithstanding its express power under Clause 3, Section 8, Article I of the Federal Constitution to regulate foreign and interstate commerce, occasionally has to resort to implied powers under Clause 18, Section 8, Article I, of that instrument. The propriety of this was recognized in Waters v. Phillips (284 Fed. 237), in which the court held that when the United States, in the lawful exercise of its authority, builds a dam for the purpose of navigation, the waterpower developed by such dam may be utilized by the United States or may be leased to any concern engaged in the distribution of electrical energy.

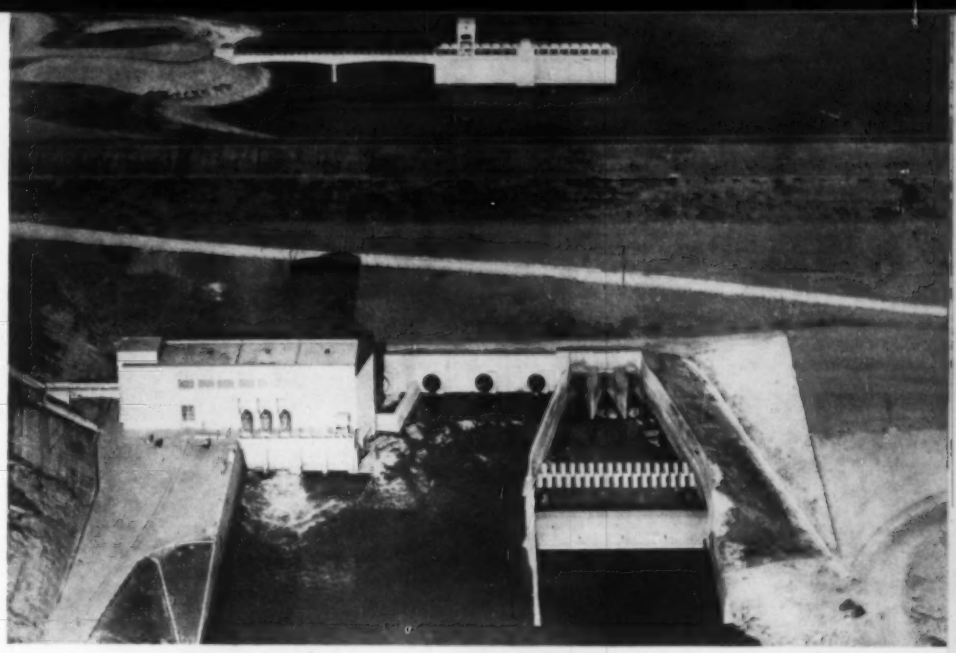
POSSUM KINGDOM (MORRIS SHEPPARD) DAM AND POWERHOUSE on Brazos River near Mineral Wells, Tex., is of Ambursen long-span, massive-buttress type, 190 ft high and 2,740 ft long, on shale and broken sandstone formation. Buttresses of 10-ft maximum thickness are spaced 40 ft center to center. Dam and powerhouse, designed by Ambursen Engineering Corp. in 1938 for Brazos River Conservation and Reclamation District, a Texas state authority, are part of comprehensive Brazos Basin development program involving twelve major dams and eight hydroelectric plants, of which Whitney Dam, now being built by U.S. Engineer Department, is furthest downstream. Spillway has nine 12-ft-high automatic roof-weir crest gates. Final powerhouse installation consists of three 17,000-hp vertical-shaft Francis turbines, each driving 12,500-kva generator under variable head ranging from 130 ft down to 63 ft.

Gradual Growth of Federal Participation

The following incidents indicate the gradual growth of the federal government's participation in the development of hydroelectric energy.

The first specific Congressional authorization for the construction of a power project in a navigable stream was the act of July 5, 1884, (23 Stat. 154), which authorized the construction of a power dam by private interests at St. Cloud, Minn.

The act of May 14, 1896 (29 Stat. 120), authorized the Secretary of the Interior, under general regulations to be fixed by him, to permit the use of right-of-way, not exceeding 40 acres, upon the public lands and forest reserves for the purpose of generating, manufacturing, or distributing electrical power. This was the first specific legislation dealing with rights-of-way



AERIAL VIEW OF DENNISON DAM, on Red River in northern Texas, shows downstream face of powerhouse with transformers located on draft-tube deck. Surge tank is seen between powerhouse and rolled earth-fill dam. Powerhouse has space for expansion to accommodate future generating units. Intake gate structure (background) for penstocks and flood control conduits (foreground) are also seen in view. Reservoir capacity is nearly 6,000,000-acre-ft.

across the public domain for the transmission of electric energy.

The act of June 28, 1902 (32 Stat. 408), authorized the Secretary of War to grant leases or licenses to the highest responsible bidder for the use of waterpower at such rates and on such conditions and for such periods of time as he deemed expedient.

In 1903 President Theodore Roosevelt vetoed H.R. 14051, which purported to grant the consent of Congress to N. F. Thompson & Associates to erect a dam and construct a power station at Muscle Shoals, Ala. The following is quoted from the President's veto message:

"I think it is desirable that the entire subject of renting privileges of the kind referred to in this bill should be considered in a comprehensive way and that a general policy appropriate to the new conditions caused by the advance in the electric science should be adopted under which these valuable rights will not be practically given away, but will be disposed of after full competition in such a way as shall best conserve the public interests."

In the act of June 21, 1906 (34 Stat. 386), Congress for the first time enacted general legislation fixing conditions which were thereafter to attach to each specific authorization for the construction of waterpower works in navigable waters. The act provided for the approval of plans and specifications by the Chief of Engineers and the Secretary of War and gave these officers authority to require, as a condition of approval, *at any time*, the construction, maintenance, and operation by the grantee without expense to the United States of locks and other navigation facilities, or, if such facilities were constructed by the United States, to require the conveyance by the grantee at its own expense of the lands needed by the United States for such purposes, together with free use of waterpower for operation of such facilities.

Section 12 of the act of March 3, 1909 (35 Stat. 815) authorized the Secretary of War to lease for power purposes the water in the St. Marys River at Sault Sainte Marie over and above the amount required for the uses of navigation.

The act of June 23, 1910 (36 Stat. 593), amended the General Dam Act of June 21, 1906, by limiting the grants to 50 years, by reserving the right to revoke the grant at any time for public uses upon payment of reasonable value for works constructed, and by directing that consideration be given to the bearing of any proposed plan on a comprehensive scheme of development. The act also directed that charges be collected sufficient to reimburse the United States for costs of investigations made or of works necessary to restore prior conditions of navigability, and to compensate for the benefits received from headwater improvements or forested watersheds operated or maintained by the United States.

Section 12 of the act of July 25, 1912 (37 Stat. 201), provided as follows:

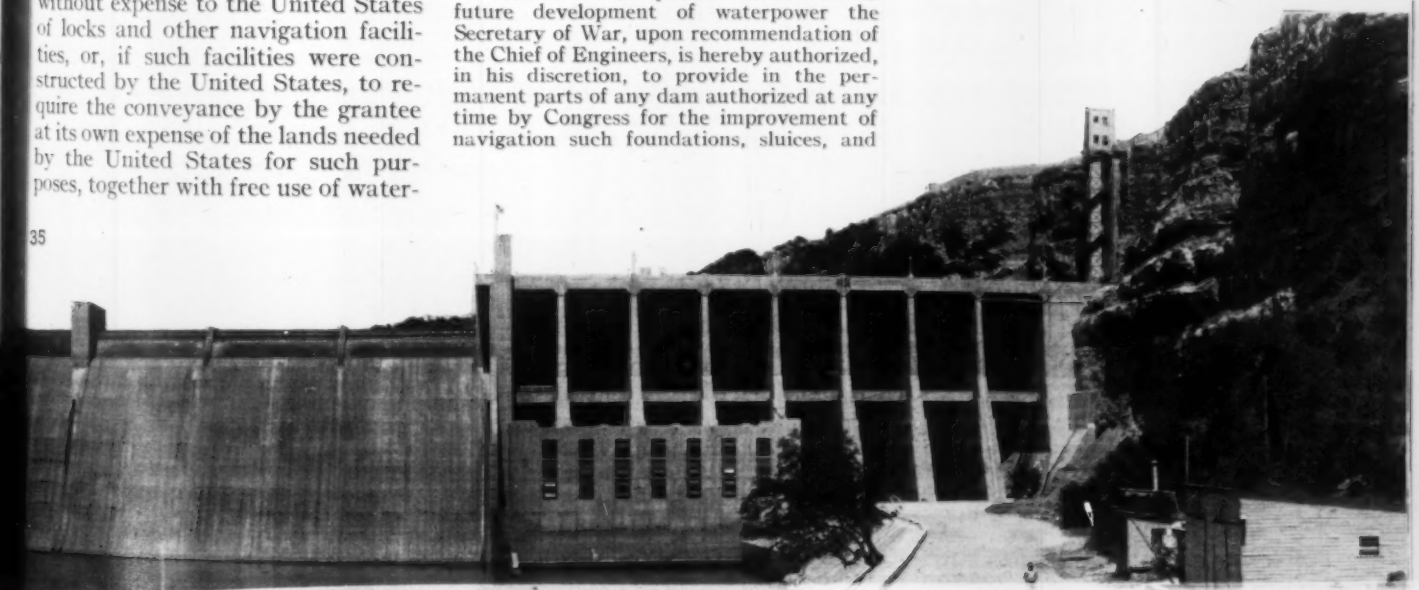
"In order to make possible the economical future development of waterpower the Secretary of War, upon recommendation of the Chief of Engineers, is hereby authorized, in his discretion, to provide in the permanent parts of any dam authorized at any time by Congress for the improvement of navigation such foundations, sluices, and other works, as may be considered desirable for the future development of its water power."

Federal Right to Hydroelectric Power

Report of the Subcommittee of the Committee on the Judiciary, U.S. Senate, on Senate Resolution 44, 64th Congress, directing the Committee on the Judiciary to report to the Senate on the power of the government over the development and use of waterpower within the respective states, contains the following significant paragraph:

"If, for the purpose of improving the navigability of a stream carrying interstate commerce, the federal government constructs and maintains a dam, with locks and gates, on its riparian lands or on lands in which it has acquired an easement for such construction and maintenance, the government has the undoubted right to establish and maintain, in connection with such dam, an electric power plant for the purpose of furnishing motive power to operate such locks and gates. And the federal government has the right to sell, lease, or rent, for compensation, any surplus power that may arise from and be an incident to such an improvement of navigation. (Kaukauna Water Power Co. vs. Green Bay & Mississippi Canal Co., 142 U.S. 254.)"

In 1913 the Supreme Court, in United States v. Chandler-Dunbar



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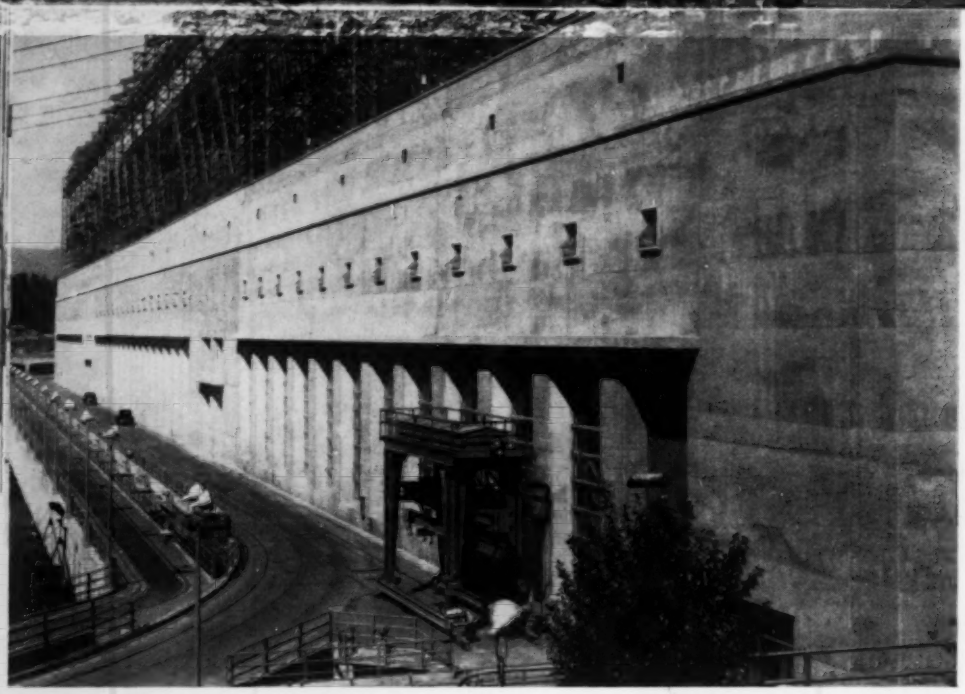


BONNEVILLE PROJECT, on Columbia River in Oregon, has ten-unit powerhouse, spillway dam 1,300 ft long and two connecting levees. View shows downstream face of powerhouse, draft-tube deck and draft-tube stop-log gantry. Switchyard structures are mounted on powerhouse roof.

Co., (229 U.S. 53) rejected the contention that there could be any private ownership of the water or the power in a navigable stream as against the federal government.

House of Representatives Report No. 16, 64th Congress, submitted in 1916, on waterpower development and use of public lands contains the following interesting paragraph:

"Prior to the act of February 15, 1901, there was no legislation on the subject at all; waterpower sites went to patent unmolested, either as parts of homesteads or by purchase, and were given no federal attention whatever. Under this procedure a large number of the power sites on the public domain were frittered away and have passed into private ownership beyond regulation, beyond control. As we look back on this procedure it seems like criminal neglect. Many of the valuable waterpower sites of the country passed as fast as eager private concerns and persons could grab them under the several lax laws then in existence. These are now forever, in part, to be enjoyed by the few who at will may practice extortion and monopoly upon the consuming public, subject only to inadequate state regulation when the business is intrastate and with little or no regulation when the concern is doing an interstate business. The titles to these sites have forever passed out of the hands of the federal government and the people."

Section 18 of the act of August 8, 1917 (40 Stat. 250, 269), created the Waterways Commission, to bring into coordination and cooperation the engineering, scientific, and constructive service, bureaus, boards, and commissions related to the study, development, or control of waterways and water resources, with a view to uniting such services in investigating all watersheds in the United States, with respect to the development, improvement, regulation, and control of navigation and the related questions of irrigation, drainage, forestry, arid and swampland reclamation, clarification of streams, regulation of flow, control of floods, utilization of waterpower, prevention of soil erosion and waste, storage, and conservation of water for agricultural, industrial, municipal and domestic uses, cooperation of railways and waterways, and promotion of terminal and transfer facilities. The Waterways Commission was required to formulate and report to Congress a comprehensive plan or plans for the development of waterways and the water resources of the United States for the purpose of navigation and for every useful purpose.

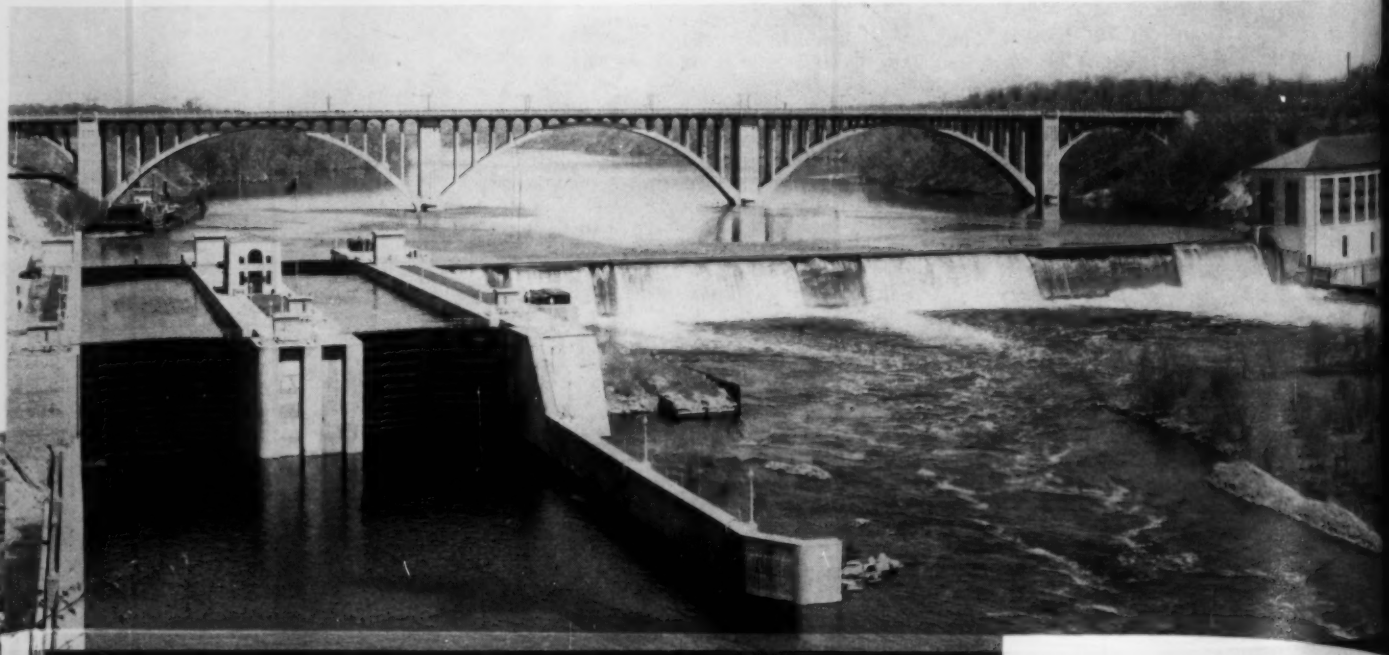
Federal Power Commission Created

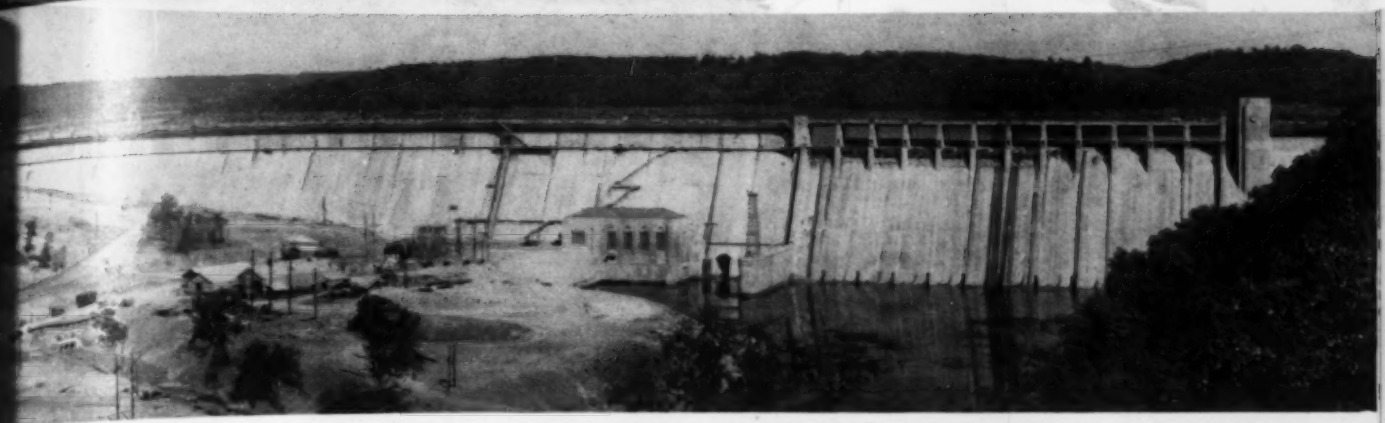
The Federal Water Power Act of June 10, 1920 (41 Stat. 1063), created the Federal Power Commission and vested the commission with authority to regulate, through a permit system, hydroelectric projects on the public domain and in navigable rivers and their tributaries. This act superseded the General Dam Act of 1906, as amended by the act of June 23, 1910.

Section 3 of the act of March 3, 1925 (43 Stat. 1186), provided:

"The Secretary of War, through the Corps of Engineers of the United States

CONSTRUCTED IN 1911 on gravel and sand foundation, Twin City lock and dam (Mississippi River Dam No. 1), located above Hastings, Minn., is first Ambursen-type dam ever built by U.S. Engineer Department. Powerhouse built in 1924 by Ford Motor Co. is under lease agreement whereby Ford furnishes 225,000 kwhr per annum to United States, and excess power above demands of adjacent Ford assembly plant is sold to Northern States Power Co. Powerhouse contains four vertical-type Francis runner waterwheels, each of 4,500-hp capacity and driving 4,500-kva generator, under normal operating head of 37 ft, including 2 ft of hinged flashboards.





NORFORK DAM, gravity-type concrete structure near town of Norfork, Ark., on North Fork River, is unit of general comprehensive plan for control of floods on White and Mississippi Rivers and for development of water resources of White River Basin in Missouri and Arkansas. Powerhouse, constructed initially for two generating units, has space for extension for two future generating units.

Army, and the Federal Power Commission are jointly hereby authorized and directed to prepare and submit to Congress an estimate of the cost of making such examinations, surveys, or other investigations as, in their opinion, may be required of those navigable streams of the United States, and their tributaries, whereon power development appears feasible and practicable, with a view to the formulation of general plans for the most effective improvement of such streams for the purpose of navigation and the prosecution of such improvement in combination with the most efficient development of the potential waterpower, the control of floods, and the needs of irrigation: *Provided*, That no consideration of the Colorado River and its problems shall be included in the consideration or estimate provided herein."

In compliance with this provision there was submitted to Congress H. Doc. 308, 69th Congress, 1st session. This was followed by the so-called "308 Reports" on river systems, which comprise approximately 200 separate reports on all the important rivers and their tributaries in the United States. They are comprehensive examinations of entire river systems for the coordination of navigation, flood control, irrigation, and power development.

Multiple Uses Recognized

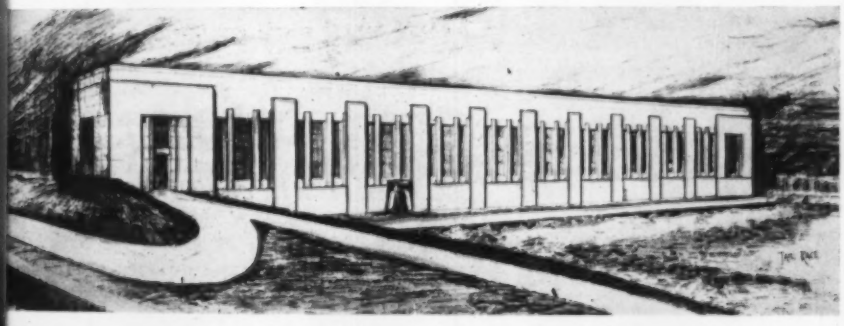
The following excerpt is quoted from the report of the National Resources Board in November 1934:

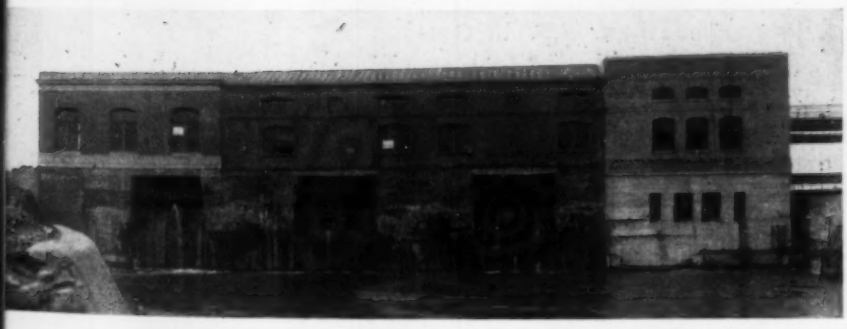
"*Multiple Uses:* It has been the custom generally to approach a water factor as presenting only one specific problem of control or use; for instance, elimination of flood hazard, or navigation, or irrigation, or power. Study of many situations indicates, however, that frequently the combination of factors is such that achievement of some particular objective may be promoted by combining other objectives with it. Usually a project is conceived because of some one hazard or of some one desired use; but if a large view is taken it becomes apparent that other uses are potential and should be included in the project, in order, on the one hand, to secure the greatest total benefit from the natural resource and, on the other hand, to make the cost of each component benefit less than it otherwise would be. Many projects have been reviewed by the committee which, although inspired by a single purpose, offer excellent opportunities for combinations which would multiply benefits and reduce the cost of any one benefit below what it would be if sought by itself. Thus a project may at first appear to involve only the element of levee or reservoir control of floods, but careful consideration may disclose that reservoir control may carry with it opportunities for power generation, water supply for adjacent communities, and recreational facilities. In exceptional instances the same dam and reservoir may be made to serve flood control, irrigation, power, and recreational purposes. A dam conceived at first solely for navigation control may offer also power generation. No matter what the originating purpose, every other reasonable purpose should be considered in defining and planning a water project."

Section 2 of the act of August 30, 1935 (49 Stat. 1028), provided in part as follows:

"That for the purpose of controlling floods, improving navigation, regulating the flow of the streams of the United States, providing for storage and for the delivery of the stored waters thereof, for the reclamation of public lands and Indian reservations, and other beneficial uses, and for the generation of electric energy as a means of financially aiding and assisting such undertakings, the projects known as "Parker Dam" on the Colorado River and "Grand Coulee Dam" on the Columbia River, are hereby authorized and adopted, and all contracts and agreements which have been executed in connection therewith are hereby validated and ratified, and the President, acting through such agents as he may designate, is hereby authorized to construct, operate, and maintain dams, structures, canals, and incidental works necessary to such projects, and in connection therewith to make and enter into any and all necessary contracts including contracts amendatory of or supplemental to those hereby validated and ratified."

The act of August 26, 1935 (49 Stat. 838) modified the Federal Water Power Act of 1920 by changing the composition of the commission to five commissioners, and by increasing its functions to include the issuance of licenses for the purpose of constructing, operating, and maintaining dams,





NEW POWERHOUSE to be installed at St. Marys Falls, St. Marys River, Mich., is shown in perspective sketch. Lower view shows old powerhouse built about 40 years ago at St. Marys Falls Canal, which will be replaced by new structure.

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SURGE TANKS and structural steel framework reach final elevation at Fort Peck Dam, 100,000,000-cu yd rolled earthfill structure on Missouri River in Montana. View of powerhouse from upstream side shows erection of precast stone surge-tank housing under way with 4 of 27 tiers completed.

water conduits, reservoirs, powerhouses, transmission lines, or other project works necessary or convenient for the development and improvement of navigation and for the development, transmission, and utilization of power across, along, from, or in any of the bodies of water over which Congress has jurisdiction or upon any part of the public lands and reservations of the United States.

A number of acts passed between 1936 and 1946 contain the following provision:

"*Provided*, That penstocks and other similar facilities adapted to possible future use in the development of hydroelectric power shall be installed in any dam authorized in this act for construction by the War Department when approved by the Secretary of War on the recommendation of the Chief of Engineers and the Federal Power Commission."

The Corps of Engineers, Department of the Army, is responsible for the development of hydroelectric energy incident to civil works activities. However, as required by Section 5 of the act of December 22, 1944 (58 Stat. 887), electric power and energy generated at reservoir projects under the control of the Department of the Army, and in the opinion of the Secretary of the Army not required in the operation of such projects, is required to be delivered to the Secretary of the Interior, who is authorized to transmit and dispose of such power and energy, except surplus electric energy generated at Sault Sainte Marie, which may be leased by the Secretary of the Army (Act of March 2, 1945, Public Law 14, 79th Congress).

The Bureau of Reclamation, Department of the Interior, is authorized to investigate, construct and operate irrigation projects west of the ninety-seventh meridian.

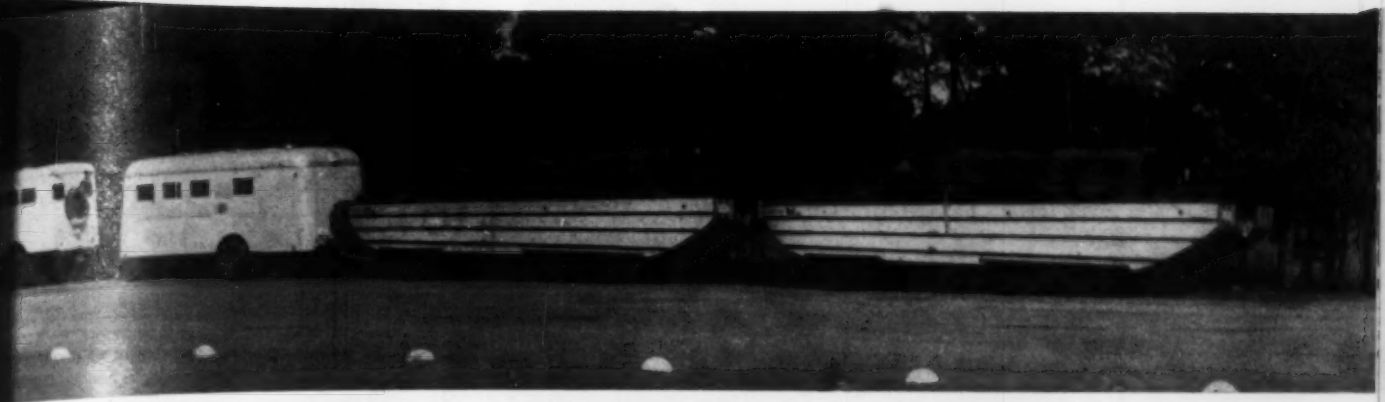
The Forest Service, Department of Agriculture, cooperates with the Federal Power Commission in field investigations and reports on applications for waterpower developments within National Forests. The activities of the Service are restricted generally to the requirements for administration of waterpower permits, and to investigating and supervising permits and licenses applied for or granted by the Federal Power Commission.

The Geological Survey, Department of the Interior, collects and publishes data pertinent to surface and underground water, such as continuous daily records giving quantities of water flowing in streams; and the chemical quality of both surface and ground water and the adaptability of these waters for domestic use, irrigation, and industrial processes of various kinds.

The Federal Power Commission is primarily the coordinating agency between the federal government and the states in dealing with power development as it affects navigation and streams upon public lands. It is not a fact-gathering agency. In its studies it depends upon the facts gathered by the Geological Survey of the Department of the Interior, Corps of Engineers of the Department of the Army, and the Forest Service of the Department of Agriculture. The Federal Power Act, the act of June 10, 1920 (41 Stat. 1063), as amended by the act of August 26, 1935 (49 Stat. 838; 16 U.S.C. 791a-825r), contains the first explicit provisions of law for federal regulation of rates, surveys and securities. The commission deals with waterpower development affecting the use of navigable rivers and of public lands or reservations of the United States. The act authorizes the commission to issue licenses to citizens, associations and corporations for the purpose of power development, and through stipulations in these licenses it gets its right to regulate. However, the commission is prohibited by the act from interfering with state regulations. Section 4 of the act enumerates the powers of the Federal Power Commission. Subsection (*e*) of that section reads in pertinent part as follows:

"To issue licenses . . . for the purpose of constructing, operating and maintaining dams . . . reservoirs . . . or other project works necessary or convenient for the development or improvement of navigation. . . . *Provided further*, That no licenses affecting the navigable capacity of any navigable waters of the United States shall be issued until the plans of the dam or other structures affecting navigation have been approved by the Chief of Engineers and the Secretary of War."

(*Continued on page 92*)



MOBILE EQUIPMENT OF BEACH EROSION BOARD FIELD RESEARCH GROUP includes two amphibious DUKW's, trailer field office and tractor shop. Two parties so equipped are now in field: Group 1, assigned to California area, studies movement of over 15 million cu yd of dredged sand deposited on beaches at Hyperion and Sunset Beach; Group 2, working in cooperation with Corps of Engineers, New York District, on sand-movement and wave study, is located in Long Branch, N.J., area.

Field Research Groups Provide Data for Design of Shore Protection Structures

WITH TWO FIELD RESEARCH GROUPS actively engaged in studies in the Long Branch, N.J., and Los Angeles, Calif., areas, the Beach Erosion Board is making general shoreline investigations as authorized under Public Law 166, 79th Congress. Field research studies now under way will provide some basis for determining the relation between the movement of beach material and natural forces such as winds, waves, tides and littoral currents. The solution of the problem will add to the information needed to design sound coastal structures and to provide economical shore protection.

Equipped with two amphibious vehicles (DUKW), a tractor shop, a trailer field office, and a reconnaissance vehicle, both field research groups are highly mobile. Special equipment includes echo-sounders, several two-way radios and means of collecting oceanographic and meteorological data.

Assigned to the California area, Field Research Group 1 is studying the effect of natural forces such as waves, tides and littoral currents on the movement of 14,000,000 cu yd of dredged sand deposited on the beach at Hyperion, Santa Monica Bay, and 1,092,000 cu yd of dredged sand deposited on Sunset Beach.

Wind and Wave Observations Made

This group obtains wind records from established U.S. Weather Bureau stations and tidal data from U.S. Coast and Geodetic Survey primary tide stations. Wave observations of height, period, and direction are made at three wave stations established in the project area.

The wave gages used are the step-resistance type developed by the Beach Erosion Board. A Rayleigh Disk wave-direction recorder is to be installed at each wave station. Data are collected on the quantity and size of the sand in suspension at different depths, using a sampling device developed in the laboratory of the Beach Erosion Board. Changes in the configuration of the ocean bottom in the problem area are determined by hydrographic surveys.

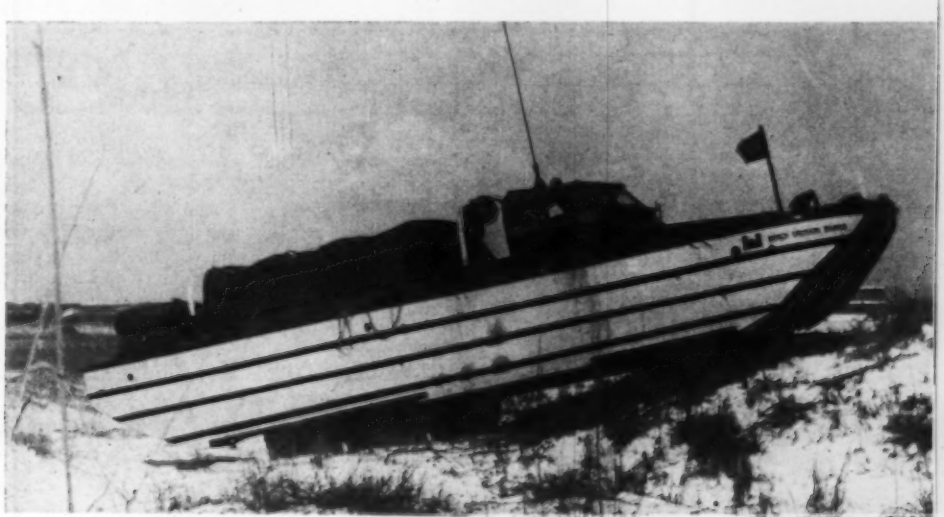
Field Research Group No. 2, working in cooperation with the New York District, Corps of Engineers, is making a sand-movement and wave study in the Long Branch, N.J., area. The movement of 600,000 cu yd of dredged material deposited in 38 ft of water is under study. The dredged material is obtained through the normal maintenance of the harbor channel in Lower New York Bay and moved to the dump area in a sea-going hopper dredge.

A meteorological and oceanographic station was established on the Long Branch fishing pier because no official stations are close enough to the problem area to furnish the required field data. The station contains instruments to record tide levels, wind velocities and direction, and wave heights in deep and shallow water. A standard U.S. Signal Corps recording anemometer and a standard U.S. Coast and Geodetic Survey recording tide gage are used.

(*Continued on page 92*)

PRESSURE-TYPE WAVE RECORDER, developed by University of California, part of equipment used in previous beach erosion study in summer of 1947, is carried by DUKW for installation in deep water off Steel Pier at Atlantic City, N.J.

FULLY EQUIPPED DUKW is capable of traversing rough beach terrain, surf and deep water offshore in connection with studies to determine effects of waves, tides and littoral currents on beach sand. Two-way radio is included in special equipment carried by DUKW.



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TEST VEHICLE consists of two-wheeled steel cart and converted six-by-six truck-type tractor with gross weight of 28,860 lb. Test loads starting at 30,000 lb are increased in 10,000-lb increments to maximum of 60,000 lb. Test cart has 18×24-in. earthmover-type tires on 8-ft centers.

Bituminous Subsealed Concrete Pavements Withstand Accelerated Traffic Tests

MERITS OF SUBSEALING as a preventive maintenance measure on airfield pavements were determined in comparative accelerated traffic tests conducted recently at Columbus, Miss., Air Force Base by the Air Installations Division of the U.S. Air Force. The test results provide a basis for determining how much the life of airfield pavement that had been subjected to traffic over a period of years, can be prolonged if subsealed prior to development of major distress, in comparison with similar but untreated pavement. A detailed description of the tests conducted at Columbus Air Force Base is given in a report published by the Headquarters Air Training Command, Air Installations Division, Barksdale, La., Air Force Base under the direction of Col. L. B. Woods, chief. A summary of the highlights of the report is presented here.

ASPHALT SUBSEALING consists of pumping highly viscous asphalt under concrete pavement at elevated temperatures for the purpose of filling underlying voids and cavities and placing a watertight membrane over the subgrade. Uniform support of the pavement is thereby reestablished and the subgrade protected against infiltration of surface water.

The practice of subsealing has been in use on stations of the Air Training Command during the past three years, and has been commonly accepted as an efficient method of correction for rocking slabs, pumping joints and settlement. The accelerated traffic test described here was conducted to establish factual data concerning such treatment when used as a preventive maintenance measure, or for subsealing prior to slab distress to prevent such distress or failure.

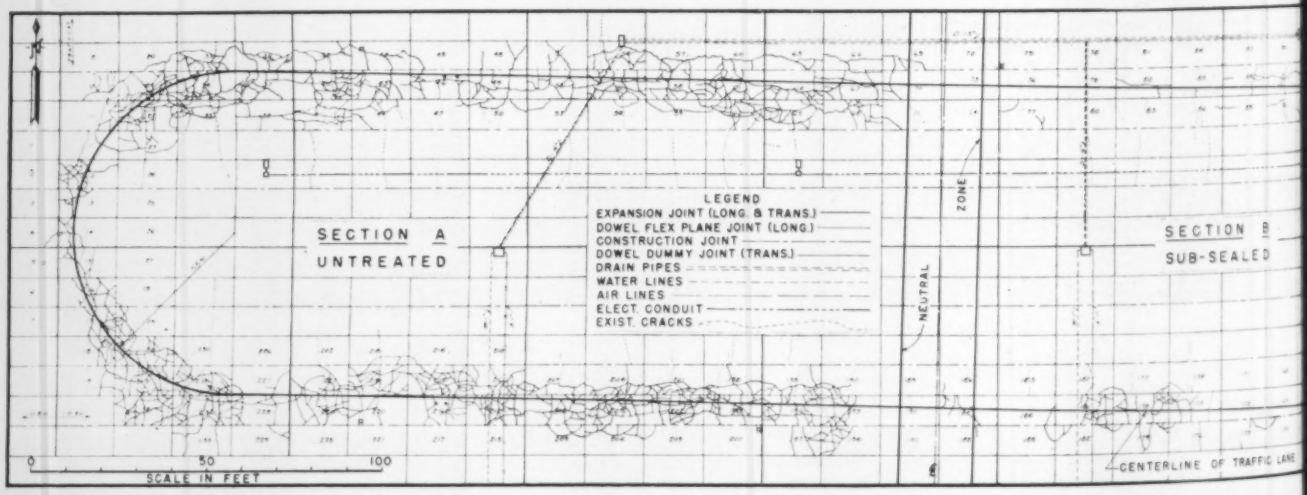
In the tests conducted on a portion of the aircraft parking apron at Columbus Air Force Base, Mississippi (Fig. 1), pavement which showed indications of imminent distress was subjected to repetitive capacity or near-capacity wheel loads. The pavement had been constructed by placing portland cement concrete directly on the subgrade. The mix design provided for a cement factor of 5.75 bags per cu yd, and a water content of 5.5 gal per bag. Straight portland cement was used throughout the paving operations. Pavement is 8-6-6-8 in. in thickness with the extra thickness tapering off in 3-ft widths. (See Fig. 2).

A test track one-fourth of a mile in length was laid out in the shape of an oval. Half of the test area was left untreated and the other half was subsealed. A test vehicle having a gross load of 30,000 lb—60 percent of the rated capacity of the pavement—was placed in operation, traveling a fixed traffic lane around the oval at approximately 10 mph, 16 hours a day, seven days a week. The gross load was increased by increments of 10,000 lb at approximate intervals of 4,000 cycles, to a maximum of 60,000 lb, which was the final load being carried at the close of the test, at 15,335 cycles.

Distress was accelerated during the test by simulating rainfall on alternate days with a street washer and fire hose. The test area was surveyed frequently each day, and distress conditions were recorded as they developed. Each new fracture was platted on specially prepared graph charts, with the date and cycle of its occurrence. A record was also kept of vertical deflections induced in the slabs by the passing wheel loads.

The test was concluded after 15,335 cycles of the test vehicle because further travel over the traffic lane

FIG. 1. CONDITIONS ON TEST OVAL at close of test indicate that subsealing is positive factor in preserving pavement. Of 70 load-bearing slabs on each section, 70 slabs in Section A (untreated) and 53 slabs in Section B (treated) are fractured. One slab in Section A has single fracture. Section B has 28 such slabs. Three slabs in Section A have but two fractures against 33 such slabs in B. Section A has total of 1,068 fractures as compared with 349 in B.



in the untreated portion of the area was impossible. Total failure occurred in 87½ percent of the load-bearing slabs in the untreated area, with all slabs fractured. All the remaining 12½ percent of the slabs were in a state of major distress. Total failure on the subsealed portion embraced 12½ percent of the traffic lane, with 24½ percent of the load-bearing slabs unfractured and 87½ percent still fit for travel with the 60,000-lb load.

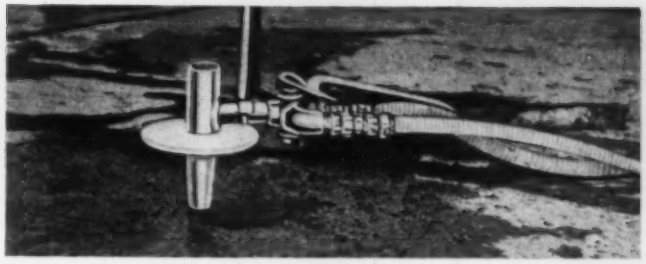
Non-Uniform Support Causes Failure

The need for any type of subtreatment of rigid pavement is caused by failure of the foundation (subgrade or base course) to support the pavement uniformly at all points. Likewise, when a rigid pavement is structurally sound, of proper design mix, and not subjected to loading in excess of its rated compressive strength, failure is caused by non-uniformity of support in the foundation. This non-uniformity may be caused by various conditions, namely:

1. Additional consolidation of the base course under traffic in spots where maximum density was not obtained during construction, causing unpatterned fractures where the weakness existed.

2. Leakage of surface water through the joints into a silty or clayey subgrade having a high plasticity index, causing swelling under joints and along slab edges, and consequent voids under the center of slabs, with resultant longitudinal or transverse center fractures.

3. Pumping at joint intersections under passing wheel loads, most prevalent on pavement without load-transfer devices, causing voids under slab corners and along joints, and in turn causing diagonal breaks across the corners, with eventual distress throughout the entire slab.



INJECTOR NOZZLE used in subsealing operation has three-way valve which controls circulation of asphalt into nozzle or through return hose to distributor tank. Wood plugs are placed in holes already pumped.

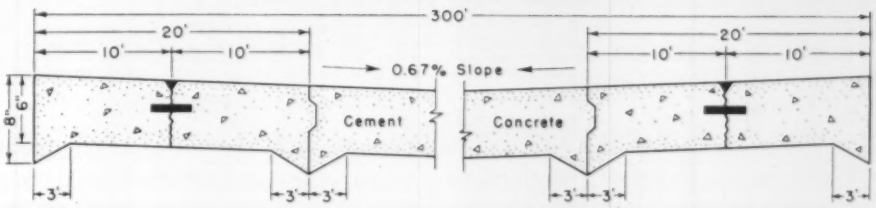


FIG. 2. DETAILS OF TYPICAL SECTION of concrete pavement tested are given here. Longitudinal expansion joints are spaced 80 ft on centers, have thickened edges and no load transfer devices. Longitudinal construction joints are 20 ft on centers, have thickened edges and are keyed with tapered tongue and groove. Transverse expansion joints are 80 ft on centers, have ¾-in. smooth round dowels 16 in. long, 12 in. on centers and no thickened edges.

4. Subgrade settlement along underground pipelines or other weak spots, causing irregular slab fractures and depressions.

Efforts have been made for a number of years to correct such distress by pumping low-viscosity mud, cement-mud slurry or cement grout under the pavement. Various degrees of success have been obtained by these methods, but they have failed in some respects owing to either the method or the material used. Where plain mud is used, pumping reoccurs as water again makes contact with the subgrade. Other slab distress is usually induced whether mud, cement slurry or plain grout is used. Since these are mixtures, the solids are carried in suspension, and start to settle out of the vehicle immediately. The deposits of solids are therefore greatest in the immediate vicinity of the hole through which the mixture is pumped. Other voids are thus created through this pyramiding action, with resultant fracture along the line of injection holes or some distance from and parallel to the holes.

In an attempt to overcome the deficiencies of mud and cement slurries, the highway departments of Ohio and Texas experimented with asphalt as a filler agent. Asphalts of low penetration and high melting point were heated in kettles and pumped under the pavement. The method proved successful, but progress was very slow and the cost was prohibitive, often running as high as 70 to 80 cents a gallon. The first asphalt subsealing work on airfield pavements was performed in this manner at Brooks Field, San Antonio, Tex., under the direction of staff engineers of the Eighth Service Command during the winter of

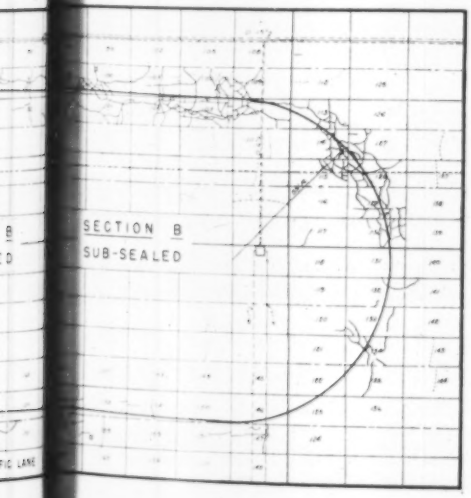


TABLE I. LOAD AND CYCLE RECORD

Load, Lb	Date Begins	Date Ends	Total Previous Cycles	No. of Cycles at Indicated Load	Cycles to Date
30,000	7–11–47	7–19–47	0	4,281	4,281
40,000	7–20–47	7–24–47	4,281	1,497	5,778
40,000	7–24–47	7–27–47	5,778	1,172	6,950
40,000	7–27–47	7–30–47	6,950	1,331	8,281
50,000	7–30–47	8– 1–47	8,281	794	9,075
50,000	8– 1–47	8– 6–47	9,075	812	8,887
50,000	8– 6–47	8–16–47	9,887	845	10,732
60,000	8–16–47	8–23–47	10,732	1,000	11,732
60,000	8–23–47	8–29–47	11,732	554	12,286
60,000	8–29–47	8–31–47	12,286	1,019	13,305
60,000	8–31–47	9– 4–47	13,305	1,192	14,497
60,000	9– 4–47	9–10–47	14,497	838	15,335

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TOTAL FAILURE OF SLAB in untreated side of neutral zone (above, left) is observed after about 8,000 cycles. Test vehicle is detoured after total failure of slabs in untreated section (center) at 11,752 cycles. Area in subsealed section (above, right) is undistressed after 11,752 cycles. Tests were discontinued at 15,335 cycles with many slabs in treated section showing little or no distress after carrying 60,000-lb load through 4,603 cycles.

1944. The work was satisfactorily accomplished, but production was slow and costly.

Efforts to speed up the process by using multiple melting kettles proved clumsy, and it was finally decided to try a hot delivery from the refinery. An insulated railroad tank car was loaded at 450 deg F at the refinery and rushed to the field. The operation was successful beyond expectations, and hot deliveries have since been utilized. Tank cars are loaded at between 450 and 500 deg F and shipped as far as six to eight hundred miles. Loss of approximately 1 deg of heat per hour is entailed in shipment but, by circulation of the asphalt through a retort heater immediately after delivery, it is quickly restored to a pumping temperature of 400 deg F plus.

Substantial Reduction in Cost

Costs were immediately lowered from approximately 60 cents per gal to approximately 18 cents per gal, and further refinements in the work gradually reduced the cost to between 10 and 15 cents per gal, depending on the extent of the project and the rate of application.

Asphalt is also a mixture, but there is no tendency of any ingredient to settle out during heating and handling and the slight percentage of shrinkage in cooling is for all practical purposes uniform throughout. The low viscosity of the hot material causes it to penetrate small openings and cavities, reestablishing uniform contact between the supporting foundation and the pavement slab. Even though the asphalt is still a liquid when chilled, it is not subject to rapid displacement, and is therefore nearly as constant as the subgrade itself in support of the rigid pavement.

Not only are the cavities filled and uniform pavement bearing reestablished, but moisture is driven out through forward holes and cracks and the subgrade is dried considerably by the hot liquid. Distressed pavements that were treated $2^1/_2$ years ago are still carrying normal loads even though they were so distressed at the time that complete failure was imminent and replacement was being considered.

Conclusions Based on Analysis of Test Results

Observations made during the test and analysis of data assembled in the report of the Columbus Air Base tests lead to certain conclusions concerning bituminous subsealing as a preventive maintenance measure. Conclusions can also be drawn concerning construction features that either abetted or deterred distress and failure under the accelerated traffic on the test course. These conclusions are briefly stated in the following paragraphs.

1. Proper and sufficient drainage is of paramount importance in the design, construction and maintenance of concrete airfield pavements.

2. Features that might cause or encourage entrapment of moisture beneath the pavement should be meticulously avoided. Some such features existing in the test area pavement were thickened slab edges along construction and expansion joints forming V-groove depressions in the subgrade, and the valley type of drainage-way through the center of the parking apron forming a saucer-like depression covering an extensive area.

TESTS CONDUCTED IN FOUR STAGES

TEST OPERATIONS were conducted in four stages, each stage covering the number of cycles that were made with a stipulated gross load (Table I). The stages were:

1. Operations between July 11 and July 20, through 4,281 cycles, with a gross load of 30,294 lb.

2. Operations between July 20 and July 30, through 4,000 cycles, with a gross load of 40,864 lb.

3. Operations between July 30 and August 16, through 2,451 cycles, with a gross load of 50,314 lb.

4. Operations between August 16 and September 11, through 4,603 cycles, with a gross load of 60,156 lb.

3. Initial distress in the form of subgrade pumping occurred almost invariably along the construction joints. Initial failures were likewise in the area of most moisture entrapment near the center of the valley drain.

4. Wherever it is considered necessary to incorporate such features as those mentioned in (2) above in pavement design, subdrainage features should also be incorporated to permit the escape of water which might enter through the pavement, and which otherwise would be trapped and would infiltrate into the subgrade and soften it.

5. Tongue-and-groove keys in construction joints did not function properly as a load transfer device after the first general expansion and contraction cycle of the pavement. The joints remained open during the period of contraction, and each double tier of slabs between construction joints acted independently, with the construction joints serving as expansion joints.

6. Dowel bars provide an efficient means for transferring loads across the joints and for retarding pavement distress. All dowel bars should be of deformed steel except in transverse expansion joints, where smooth round dowels are required. Airfield pavement should be of uniform thickness throughout, with all joints doweled except longitudinal expansion joints. The single exception to the uniform thickness rule is the outside edge of the outside tier of slabs, where additional strength is required owing to lack of inter-support, and where thickened slab edges do not present a drainage problem.

7. A plane of weakness should be provided in all joints to allow the pavement to adjust itself to a varying subgrade without unpatterned fracturing. All joints should be grooved and filled with sealing material. Grooves should be of greater cross section than has been the custom heretofore, because the life and elasticity of the sealing material is proportionately greater as its volume is increased.

8. Bituminous subsealing, applied as preventive maintenance, before major distress in the form of excessive fracturing has developed, fills voids or cavities that have come into existence through traffic consolidation of the subgrade or from other causes, thereby reestablishing uniform support of the slabs at all points. Since the asphalt used in this work is a semisolid and therefore not subject to rapid displacement, the entire pavement structure is made more uniformly sound than when originally constructed, since weak areas in the subgrade have been consolidated to a greater density, and bearing has been reestablished thereon. This condition is only true, however, where the subgrade has not been materially weakened by over-saturation and excessive pumping.

9. Further benefits are derived from the watertight asphalt membrane that is placed between the pavement slabs and the subgrade. Infiltration of surface water is prevented and under-pavement seepage is stopped. The asphaltic coating placed on the under surface of the slab prevents absorption of moisture into the concrete by capillarity, thereby greatly reducing the cycle of expansion-contraction, and retarding or preventing spalling and buckling of the slabs. That under-pavement seepage was stopped on the untreated portion of the test area is shown by the fact that the portion of test track on Lower B (treated) immediately adjacent to the untreated pavement on Lower A, and lying wholly within the surface drainwater trap area, did not fail and showed only minor distress at the close of the test. This portion of Lower B (treated) was the most vulnerable area to such seepage, and it is to be noted that while the first total failure occurred at this point on Lower A (untreated), three adjoining slabs on Lower B (treated) were not even fractured throughout the test operations.

10. Except where total failures occurred on Section B (treated), most of the fractures were hairline cracks, and were not accompanied by spalling, widening and settlement, as were practically all fractures on Section A (untreated).

11. After the test, travel was still possible on only $12^1/_2$ percent of the traffic lane on Section A. This section was broken into small areas, all of which were in a state of major distress with total failure imminent. On Section B, $87^1/_2$ percent of the traffic lane was carrying traffic safely; $15^1/_2$ percent was in a state of major distress but no additional failures were imminent. A comparison of slab failures in the treated and untreated areas shows that slabs in Section B outlasted those in Section A at the ratio of 7 to 1.

12. The data assembled in the report substantiate the merits of bituminous subsealing as a preventive maintenance measure.

Quarter Million Yards of Dirt Moved in Less Than 48 Hours

HEAVY EARTHMOVING MACHINES and skilled operators set speed record in park construction in Peoria, Ill., by moving a quarter million cubic yards of dirt in less than 48 hours. Million dollars worth of rugged equipment, numbering 140 pieces, was used in leveling and grading 160 acres of land in record two-day period. Entire operation—work that would have cost $90,000—including operation of machines, machines themselves, gas and oil they used, food workers ate and lights which made night work possible, is result of voluntary effort. Spectacular achievement demonstrates results obtainable through concentrated civic cooperation.—Goodyear News Service.

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Navy Dedicates New Research Laboratory at Inyokern, Calif.

WITH IMPRESSIVE CEREMONIES before a large crowd of scientists, industrial executives, high military officials, and Navy workers, the Navy recently dedicated its huge new $8,000,000 Michelson Research Laboratory at the Naval Ordnance Test Station located in the heart of California's Mojave Desert. Named in honor of the late Dr. Albert A. Michelson, noted American physicist and Nobel Prize winner, the laboratory is said to be the most complete scientific research facility of its type in the world. It is equipped with facilities for basic and applied research in the fields of physical and chemical science, aerophysics, mathematics, electronics, metallurgy, ballistics, and for development work on propulsion systems for rockets and missiles, fire control and guidance systems, and on other ordnance components. Research at the Michelson Laboratory is under the direction of Dr. L. T. E. Thompson, who is aided by a large staff of scientists and technical personnel.

ABUNDANT NATURAL LIGHTING is enjoyed by technicians at new Michelson Laboratory. Lattice-type cement awnings overhanging all windows keep out direct sun rays but admit maximum diffused light.

BUILT AT A COST of about $8,000,000, the Navy's new Michelson Research Laboratory at Inyokern, Calif., which contains $7\frac{1}{2}$ acres of floor space, all air-conditioned, is virtually a self-sufficient science factory. The research and development work being done at Inyokern is supported by a community of more than 12,000 people who live in the Navy's completely modern little city, 150 miles northeast of Los Angeles.

The Naval Ordnance Test Station was first organized in the summer of 1943 as a rocket testing station to serve primarily during the war as an adjunct to the California Institute of Technology, which was then undertaking a rocket development program. Since that time, its mission has rapidly expanded and it is now considered one of the most important scientific research and military installations in the nation.

The laboratory has extensive service equipment including shops, technical library, standards of measurement, materials testing facilities, and special altitude–weather control laboratories. The main section of the building, two stories in height, is constructed as four segregated buildings with approximately 6 in. between each building for earthquake movement and expansion and contraction. Accordion-type copper flashing connects each section of the building. Six wings join the main laboratory buildings. The three-story shop building is built in two sections, and the heat-treating foundry and electro-finishing facilities are located in Wing 6, built in four sections, making a total of 16 separate but connected buildings.

Still under construction in the laboratory are the all-weather and altitude testing rooms. Here the Navy will be able to produce custom-made weather at will, simplifying the testing of new weapons under simulated atmospheric conditions—such as sand storms, icing, rain, salt spray, wind, altitude changes, or any combinations of the above.

Pneumatic control system for the entire building includes approximately 21,000 ft of $\frac{1}{4}$-in. copper tubing, 233 separate zones in the laboratory and wings, 13 separate zones in the shop building and 3 zones in the heat-treating portion of Wing 6. Partitions in the main laboratory and wings are white baked enamel filled with 2-in. insulation. These partitions are movable, permitting very flexible spacing for laboratory and office requirements. This flexibility required each outlet

COMPLETELY AIR-CONDITIONED Michelson Laboratory, recently dedicated at Naval Ordnance Test Station, Inyokern, Calif., is equipped with most modern instruments and machines for conducting basic and applied research in many fields of science.

from the trunk ducts to be a separate zone; therefore all laboratory wings and the first floor of the main section are made up with twin ducts, one with constant-temperature hot air and one with constant-temperature cold air. A pair of mixing dampers under control of a thermostat for each outlet positions the damper and controls air temperature in each zone. The administrative office section of the laboratory building as well as the shop building is not so critically controlled, being zoned for exposure and localized conditioning requirements.

Total heating requirements of the laboratory and shop building are 25,974,760 Btu per hour. Steam at 100-lb pressure is supplied from a central-system steam plant at the Navy base. High-pressure steam is piped through tunnels in the laboratory and reduced at various take-off points to 5 lb, where it is used in steam coils for preheating and reheating. Total Freon charge in all systems is 14,000 lb. The power generating facilities of the laboratory produce a total of 4,000 hp.

Approximately 6,000,000 lb of galvanized sheet iron makes up the duct systems and weatherproofing housing over exposed ducts and equipment on the roofs of the building. All sheet-metal work within the building is insulated with 1-in. semi-rigid block mineral-wool insulation. All ducts outside the building have 2-in.-thick mineral-wool block insulation with a galvanized sheet-metal covering outside the insulation.

Research Department

The Research Department at Michelson Laboratory has a two-fold responsibility: First, to obtain and evaluate the knowledge required to carry out the assignments given to the station by the Bureau of Ordnance; and second, to pioneer in the discovery of new scientific phenomena or relationships and investigate their applicability, especially as regards ordnance use. To fulfill these responsibilities the Research Department performs basic and applied research in chemistry, mathematics, physics, and the applied sciences.

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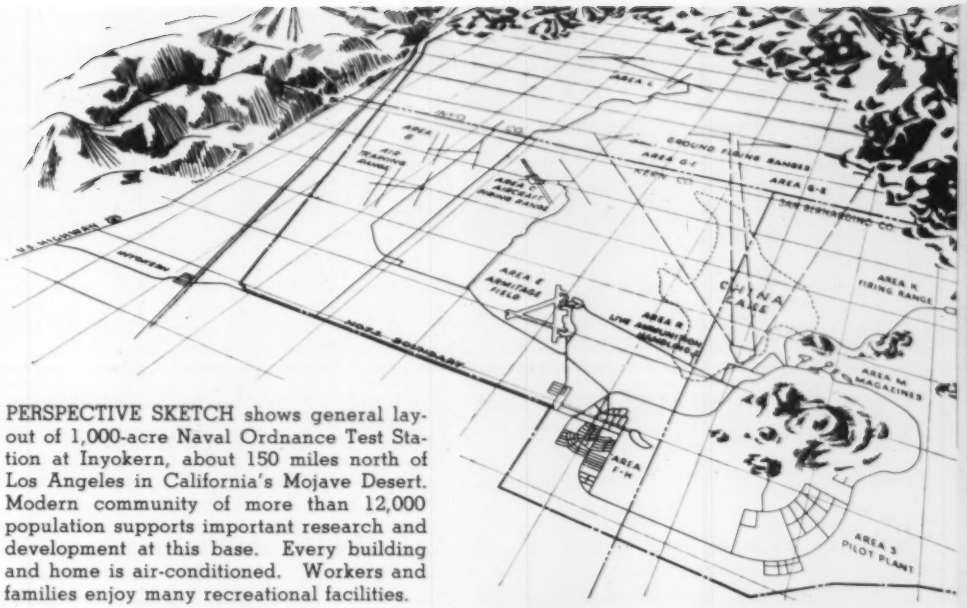
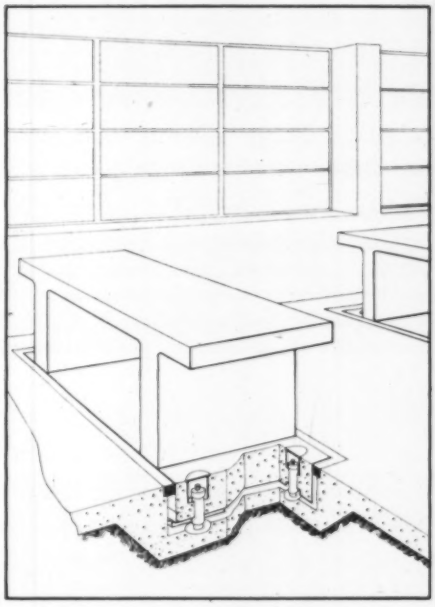


PERSPECTIVE SKETCH shows general layout of 1,000-acre Naval Ordnance Test Station at Inyokern, about 150 miles north of Los Angeles in California's Mojave Desert. Modern community of more than 12,000 population supports important research and development at this base. Every building and home is air-conditioned. Workers and families enjoy many recreational facilities.



FLOATING INSTRUMENTATION TABLES constructed on special shock-absorber springs and cork mountings are completely free of vibration.

ALL INTERNAL PARTITIONS of Michelson Laboratory are movable, permitting extremely flexible spacing for laboratory and office requirements.

PLANNING OF LABORATORY with large modern machine shop takes into consideration over-all needs of research and development program, including distance to nearest industrial area and need for quick delivery of parts or assemblies. Highly diversified, virtually self-sufficient shop is result. Shop can handle some types of heavy work which otherwise could not be done west of the Mississippi.

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DESIGNED PRIMARILY TO PERMIT SPEEDIER ERECTION with no increase in cost over brick and timber construction, "Type A" house—one of three types of steel-frame structures developed to meet Britain's postwar housing shortage—provides higher standards of construction than conventional prewar housing. Despite material shortages and delays, 25,000 skeleton frames have been erected.

Steel-Framed Structures Alleviate Britain's Low-Cost Housing Problem

DONOVAN H. LEE, M. ASCE
Consulting Engineer, London, England

CONSTRUCTION OF 36,548 steel-framed houses is part of England's effort to overcome the serious housing shortage which resulted from seven years of war and extensive destruction by air raids. The semi-prefabricated type of house was developed by the author for the British Iron & Steel Federation after a series of investigations of various types of low-cost dwellings meeting somewhat higher standards than conventional prewar housing. Despite the success of the new-type structure and the stringent needs for housing, the present serious shortage of steel in Great Britain has temporarily halted construction of the steel-frame type of house.

AS A RESULT OF STUDIES of types of construction adaptable to mass production of low-cost dwellings in England, three designs of 60-year-life houses were developed. The investigation, sponsored by the British Iron & Steel Federation, was not limited to any particular method of construction, and reinforced concrete was not excluded. Many designs were developed and compared for cost and for suitability to mass production with particular regard to the shortages of many building materials as well as skilled labor.

Prototypes of the three accepted designs were built at the Ministry of Works Demonstration Housing Site at Northholt near London. These were Types A, B and C, and all were planned on a modular grid of 3 ft 6 in.

Type A consisted essentially of a light hot-rolled steel-framed skeleton with protected metal roof, galvanized phosphated and painted upper facing, and brick veneer for the lower story. Internally the floor construction consisted of steel joists with a concrete slab poured in situ on expanded metal centering.

Type B consisted essentially of a framework constructed entirely of cold formed and pressed light-gage sections with the roof truss connections formed largely by projection resistance welding. Both these types were what is known in England as non-traditional construction in that they did not involve sufficient prefabrication to be described as prefabricated houses.

Type C was fully prefabricated and consisted essentially of steel-framed sheet-steel wall panels two stories high, with cover strips at the joints. The 3-ft 6-in. module on which the house was planned was also the width of the panels and the cold-formed floor joists connected with the walls at the joints between panels. The roof construction consisted of cold-formed sections projection resistance welded into trusses, and the internal construction consisted essentially of plasterboard walls with fiber-board insulation backing and tongue-and-groove flooring. Type C design required 450 man-hours at the site for erection as compared to 1,700 man-hours or over for a house of conventional construction.

SINCE THE ROLLING and fabricating capacity of the British steel industry exceeds its steel-making capacity, England has depended to some extent on the importation of ingots from the United States and elsewhere. The steel strike in the United States early in 1946 temporarily affected the steel supply in England and delayed initial supplies of fabricated steel for the houses described herein as well as for other urgent rehabilitation work.

To a large extent these prototypes were a demonstration of the uses of new materials and new designs. Some of them were only suitable for conditions which did not, in fact, prevail subsequently in the material and skilled labor fields. Experience and technical discussions with government departments indicated that the Type A design was the most suitable for mass production owing to the greater fabricating capacity for large quantities of hot-rolled steel. On February 1, 1946, manufacture was started on components for 30,000 houses following a modified Type A design subsequently known as Type A.1. Besides these houses for England, 5,500 houses of slightly different type (Type A.2) were started for Scotland and 1,048 houses in fours coupled together (Type A.3) for special sites in Engand.

At that time the government had under way a large-scale program for the manufacture of prefabricated temporary houses of several types, a program considered to be the only means of promptly meeting the very serious housing shortage. Since the British government had to plan on writing off the cost of the temporary houses over a period of about ten years and since the cost per unit of floor area provided was as high as, and in some cases much higher than, either normal brick and timber construc-

COLD FORMED AND PRESSED light-gage sections with welded roof trusses make up steel skeleton of "Type B" design (above, left). Little prefabrication is involved, but rate of completion is much higher than for comparable brick and timber houses. Facing on finished "Type B" structure pictured here is clapboard and stucco.

tion or the steel-framed permanent type of house here described, efforts were made to bring the permanent houses into production as quickly as possible.

One of the main obstacles to the construction of houses of traditional type was the scarcity of brick. During the latter part of the war most brick works practically closed down, and a long time was required to bring production back to anywhere near the prewar level. At present brick production is only about 60 percent of prewar. The problem was further complicated by serious labor shortages in foundries and in some other industries, which created great accumulations of unfilled orders for other building components.

Considering all the circumstances in effect when the production of these houses was started two years ago, 30,000 was considered a satisfactory compromise between the substantial need for steel for other purposes and the urgency of rehousing the thousands of people who had been bombed out. It was impossible to predict the future supply of alternative building materials.

Notwithstanding initial delays and serious shortages of materials, fabrication of the steel units is now practically complete for the whole program, and over 25,000 skeleton frames have been erected on some 300 sites. Many of the houses have now been occupied for a long enough time to prove the value of this type of steel house both as a successful competitor of traditional construction and as a means of providing higher standards of housing and economy in fuel.

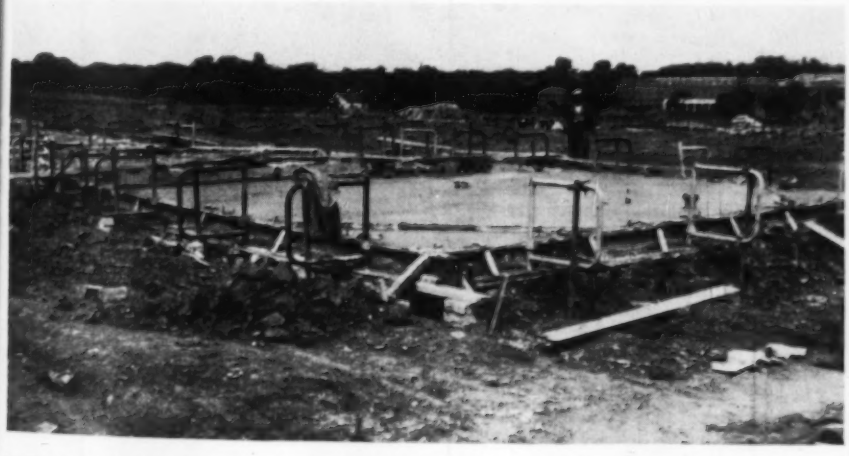
Although conditions for rapid progress at the site have been most unfavorable in England since the war, on one site 250 houses were built in 197 days. On practically all sites the rate of completion of houses has been markedly better than that for comparable brick and timber structures. To handle this program a company, Messrs. British Steel Houses Ltd., was formed jointly by the steel industry and some 45 leading contractors of Great Britain.

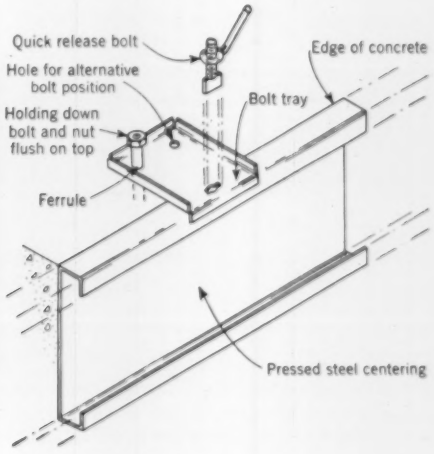
To permit accurate and rapid concreting of ground slabs, the writer designed steel forms for use on the larger sites where they could be continuously employed. These forms include a simple means of accurately locating the holding-down bolts for the steel posts, as shown in an accompanying illustration.

Since the members of the structural steel frame are light enough for handling, little justification was found for special equipment for the erection of the skeleton framework. Structural steel members were painted with one coat of red lead and one coat of bitumen solution before delivery to the site, and touched up after erection.

As the steel framework is fully protected from the weather, the paint on it is expected to last for many years after the completion of the houses. In fact, other experience with steel used under similar conditions indicates that the skeleton frames will outlast the 60-year desired life without difficulty.

The external steel facing for the upper half of the house, and in fact





STEEL FORMS ARE SPECIALLY DESIGNED for use on larger sites where continuous employment permits speedy, accurate and economical pouring of ground slabs. Forms include simple means of locating hold-down bolts for steel posts, as shown in detail above, right.

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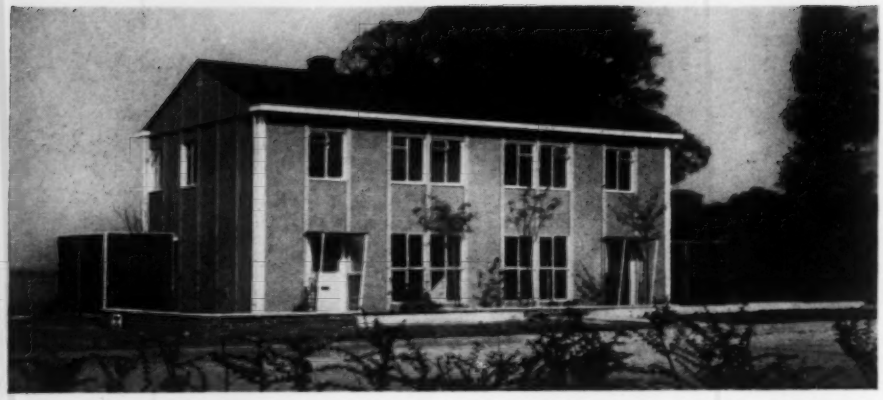


THIRD DESIGN of 60-year-life, steel-frame house, "Type C," is fully prefabricated and consists essentially of sheet-steel wall panels two stories high with cover strips at joints. Number of site man-hours required for erection is about one-fourth that needed for conventional construction.

most of the light-gage steel components, are formed from hot galvanized steel, phosphated and subsequently primed at the works with a stoved on coat of synthetic resin base, iron oxide and zinc chromate paint. The intention is of course to provide a high degree of protection to the inner face of the steel facing exposed to the semi-ventilated cavity in the outside wall. On completion of the house, two additional coats of paint are applied to the external surface.

The steel-frame type of house has probably more than achieved its purpose in spite of many supply difficulties and shortages of skilled labor. Nevertheless the curtailment of heavy construction in England at the present time and the desirability of reducing the use of steel wherever other materials can be substituted for it, may be expected to prevent continuation of the project, even though the housing shortage is still serious.

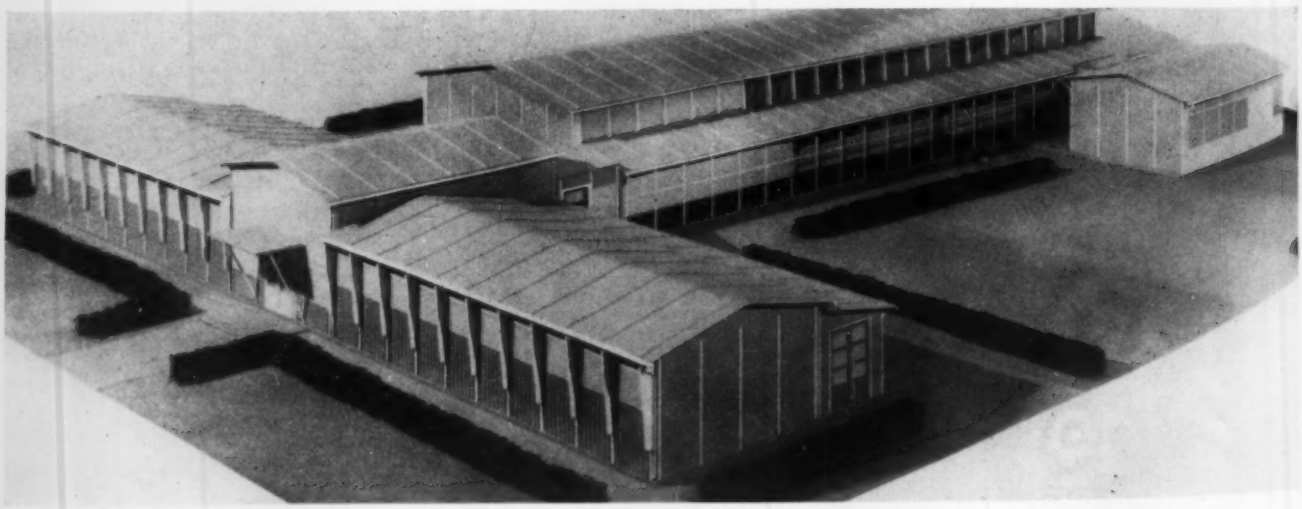
Aluminum Units Accelerate British School Construction Program

FULL-SIZE aluminum classroom components, which can be assembled in different ways to provide the permanent buildings necessary for modern schools, are being produced in Britain by the Bristol Aeroplane Co., one of five aircraft firms mass-producing aluminum houses for the British government. The aluminum components are available in a range of standard units which can be combined in various ways to provide a school of the size and type desired or can be added as new units to existing buildings.

Fully developed, the aluminum units can comprise a complete school building of two stories, including staff rooms and lavatory units. Buildings of wide span, such as assembly halls and gymnasiums, are not included since authorities may prefer to use conventional designs and construction for such units, but a hall with a span up to 50 ft can be constructed without fundamental alteration to the system.

Roofs of the aluminum units are manufactured in 16-ft 3-in., 24-ft 3-in., 32-ft 3-in. and 40-ft 3-in. spans. They are formed of gage aluminum sheet bonded to a layer of fiberboard and riveted in the factory to two light aluminum trusses at 4-ft centers, to the under side of which is fixed the finished ceiling.

End walls are formed from corrugated sheeting in framed panels filled with glass wool, but as the structural frame is complete at this point, orthodox materials, such as brick, could be used instead. The wall paneling which separates corridor from classrooms incorporates locker units.



ALUMINUM COMPONENTS, which can be assembled in various combinations to form permanent buildings or can serve as additional units for existing buildings, are helping solve Britain's demand for schools in face of a critical shortage of conventional building materials. Wall panels have uniform width but vary in height as required for classrooms, lavatories, staff rooms, corridor and cloakroom walls. Aluminum school can be delivered at site within eight weeks of order. Building to accommodate 480 pupils can be erected at cost of $112,000.

Engineers' Notebook

Charts Facilitate Determination of Stresses Under Loaded Areas

HAMILTON GRAY, Assoc. M. ASCE,
Professor of Civil Engineering, University of Maine, Orono, Me.
and the late IRA J. HOOKS, New York, N. Y.

IN THE PRACTICE of foundation engineering it is often necessary to estimate pressures induced in the subsoil by surface loads. Frequently surface loads are spread over areas which, if not themselves rectangular, are composed of rectangular subareas. Usually the intensity of load is not the same on each of the subareas, but ordinarily it is constant over any one subarea or may be assumed so. On the other hand, occasions arise in which, because of horizontal or unavoidable eccentric vertical loads, the pressure intensity varies continuously over the loaded area.

When the subsoil is composed of compressible soils, the subsidence of non-uniformiy loaded areas ordinarily results in tilting of the foundation. In many cases this action can be avoided by transmitting the loads past the compressible strata by means of piles. Economy, however, frequently dictates the elimination of piles when it is believed that the expected differential subsidence will be within permissible limits. In such cases a fairly accurate estimate of the magnitude of the subsidence is required.

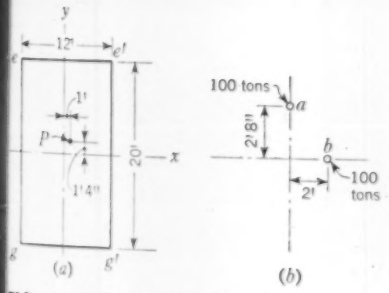


FIG. 1. RECTANGULAR AREA is subjected to normal loads of which resultant, 200 tons, acts at point *P*. Loading system shown in (*b*) is identical in every respect with that in (*a*) in its inducement of distributed reaction.

In estimating the subsidence to be expected in a given case, it is necessary to have:

1. A knowledge of the location and dimensions of the compressible stratum or strata.

2. Reliable data on the compressive characteristics of these strata.

3. A knowledge of the stress increases induced in the strata by the proposed loading.

4. Results of computations giving the estimated subsidence of the various parts of the loaded area.

To satisfy the first requirement, subsurface explorations can be carried out in such a manner as to warrant reasonable confidence in the

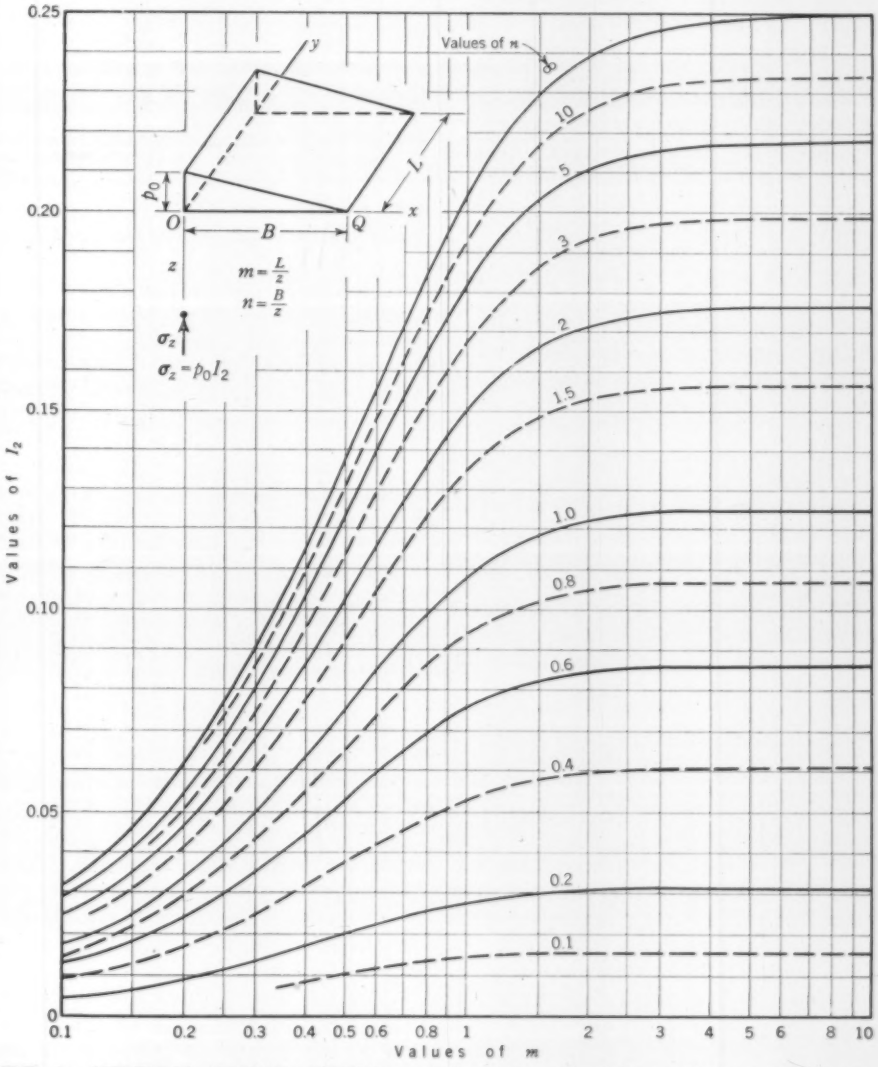


FIG. 2. VERTICAL NORMAL STRESS, σ_z induced in subsoil beneath corner *O* of rectangular area loaded as shown, is plotted by curves for varying values of *n*.

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results obtained. Nevertheless, it is true that in numerous instances, the methods employed have been such as to render the findings unreliable.

Uncertainty as to the representativeness of the data mentioned in Item 2 results primarily from the effect of the "disturbance" to which many, though apparently not all, clays are susceptible during sampling operations and laboratory testing.

Failure of the loaded soil to act as an elastically isotropic homogeneous medium throws uncertainty on the computed stresses beneath the loaded area. In addition, the true variation of surface pressure is usually not known with exactitude, while any surface shears are indeterminate, and consequently ignored.

Nevertheless the procedure outlined is not uncommonly followed, with minor variations in technique, in order to predict the behavior of various structures founded on compressible soil beds. The reliability of the prediction can only be determined by field observation on the completed structure. Although such comparisons are disturbingly scarce, close agreement is occasionally observed, and usually well publicized.

Only when the greatest precautions have been taken to avoid the errors inherent in Items 2 and 3, and when subsurface conditions are not complex, is the engineer warranted in predicting a range of probable average behavior. Whenever a close agreement between prediction and subsequent observation is obtained in spite of *complex* subsurface conditions, it is rather easy to suspect that the apparent reliability of the prediction resulted from a purely fortuitous compensation of uncertainties.

Assuming that underground conditions are fairly simple, explorations adequate, and laboratory testing of proper type and quality, the estimation of stresses in the subsoil can be expedited by recourse to graphical means, and prediction of behavior made with reasonable confidence.

Seldom, if ever, are rectangular areas deliberately proportioned so that a reversal of bearing pressure results. In other words, the resultant normal force is not so eccentric as to lie without the kern or kernel of the area. The resultant normal force can be resolved into two components of equal magnitude, one acting on each of the principal centroidal axes. It is *assumed* that the variation in bearing pressure is planar. Then each of the two forces acting by itself will produce a trapezoidal stress distribution which varies from a maximum intensity along that side of the area

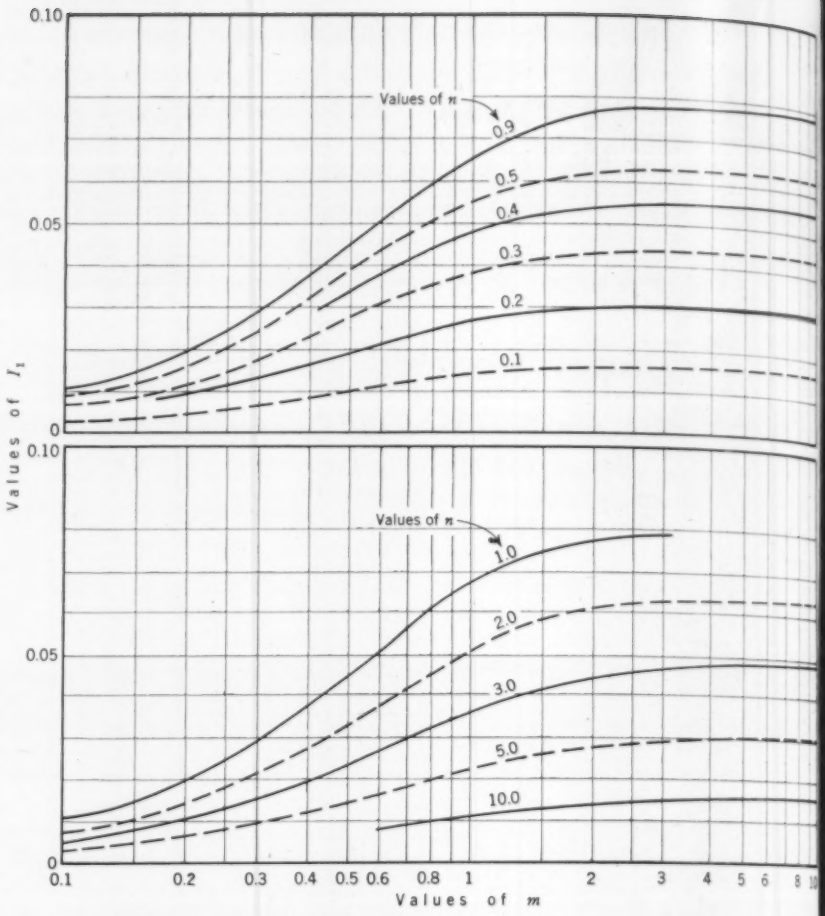

FIG. 3. VERTICAL NORMAL STRESS, σ_z induced in subsoil beneath corner, Q, of rectangular area loaded as shown in Fig. 2, is plotted by curves for varying values of n.

which lies on the same side of the centroid as does the point of action of the force, to a minimum along the opposite side. Such a trapezoidal variation can obviously be represented as the sum of a triangular variation and a uniform pressure.

For example, Fig. 1 (*a*) shows a rectangular area subjected to normal loads of which the resultant, 200 tons, acts at point P. The loading system shown in Fig. 1 (*b*) is in every respect identical with that of Fig. 1 (*a*) in its inducement of a distributed reaction.

Considering the effect of the load at point a, we obtain

$$f_a = \frac{P}{A} + \frac{M_x y}{I_x} = \frac{100}{240} + \frac{266\ ^2/_3 y}{8{,}000}.$$

The maximum intensity occurs when $y = 10$ ft, and is $F_a' = 0.416 + 0.334 = 0.750$ ton per sq ft occurring at all points of the edge ee'. The minimum intensity occurs when $y = -10$, along edge gg', and equals $F_a'' = 0.416 - 0.334 = 0.082$ tons per sq ft.

The 100-ton load at a evokes therefore a uniform reaction of 0.082 ton per sq ft and a linearly varying reaction ranging from zero along gg' to 0.668 ton per sq ft along ee'. Similarly, the other 100-ton load creates a uniform reaction of zero tons per sq ft and a linearly varying reaction ranging from zero along eg to 0.82 ton per sq ft along $e'g'$. The net effect of the 200-ton load at P is determined by superimposing the effects of the two 100-ton loads. This results in a maximum stress of 1.582 tons per sq ft at e' and a minimum stress of 0.082 ton per sq ft at g.

The computation of stresses induced in the subsoil by such a distributed surface load is readily obtained by use of the two charts, Figs. 2 and 3. These are self-explanatory and are plotted from the following formulas published by Hamilton Gray in 1943 (see CIVIL ENGINEERING for May 1943, pages 227–229):

Directly beneath point Q,

$$\sigma_z = \frac{p_0}{2\pi}\frac{L}{B} \times \left(\frac{z}{\sqrt{L^2 + z^2}} - \frac{z^3}{(B^2 + z^2)\sqrt{B^2 + L^2 + z^2}} \right)$$

and beneath point 0,

$$\sigma_z = \frac{p_0}{2\pi}\frac{L}{B}\left(\frac{z\sqrt{B^2 + L^2 + z^2}}{L^2 + z^2} - \frac{z}{\sqrt{L^2 + z^2}} + \right.$$

$$\sin^{-1}\frac{BL}{\sqrt{B^2L^2 + B^2z^2 + L^2z^2 + z^4}}\Bigg)$$

If the ordinates of any particular "n-curve" of Fig. 2 be added to the ordinates of the same "n-curve" of Fig. 3, the results represent the ordinates for a uniformly distributed load, curves for which have been published previously (see *Theoretical Soil Mechanics*, by Karl Terzaghi, M. ASCE). In utilizing these graphical aids, it is considered permissible to superimpose effects by adding or subtracting imaginary loads until the actual loading condition has been obtained.

The pressure variation over the bottom of a loaded foundation depends upon the relative stiffness of the foundation and also upon the shearing strength and bearing capacity of the adjacent soil. Whether refinements involving these factors are justified or necessary depends upon considerations that must be weighed by the designer in each individual case. It should be remembered that differential subsidence also occurs under any area that carries a uniformly distributed load.

Nomograph Solves Equations for Laboratory Soil Permeability Coefficient

B. C. Wilkas

Engineer, Bureau of Reclamation, Davis Dam, Nevada

DETERMINING THE PERMEABILITY of soils at the site of Davis Dam on the Colorado River, an earth and rock fill structure about midway between Hoover and Parker Dams, has required a large number of laboratory tests made mostly by inexperienced personnel. To solve the equations for permeability coefficients based on these tests the writer prepared a nomograph (Fig. 1) which has been found to result in increased speed and fewer errors when used by skilled technicians and computers as well as by unskilled workers.

The testing procedure to which the nomograph has been adapted is essentially that used in all the soil laboratories of the Bureau of Reclamation. A soil sample about 3 in. thick is placed between two porous plates in a cylinder 8 in. in diameter. Water is forced to percolate through the sample under constant head provided by a cali-

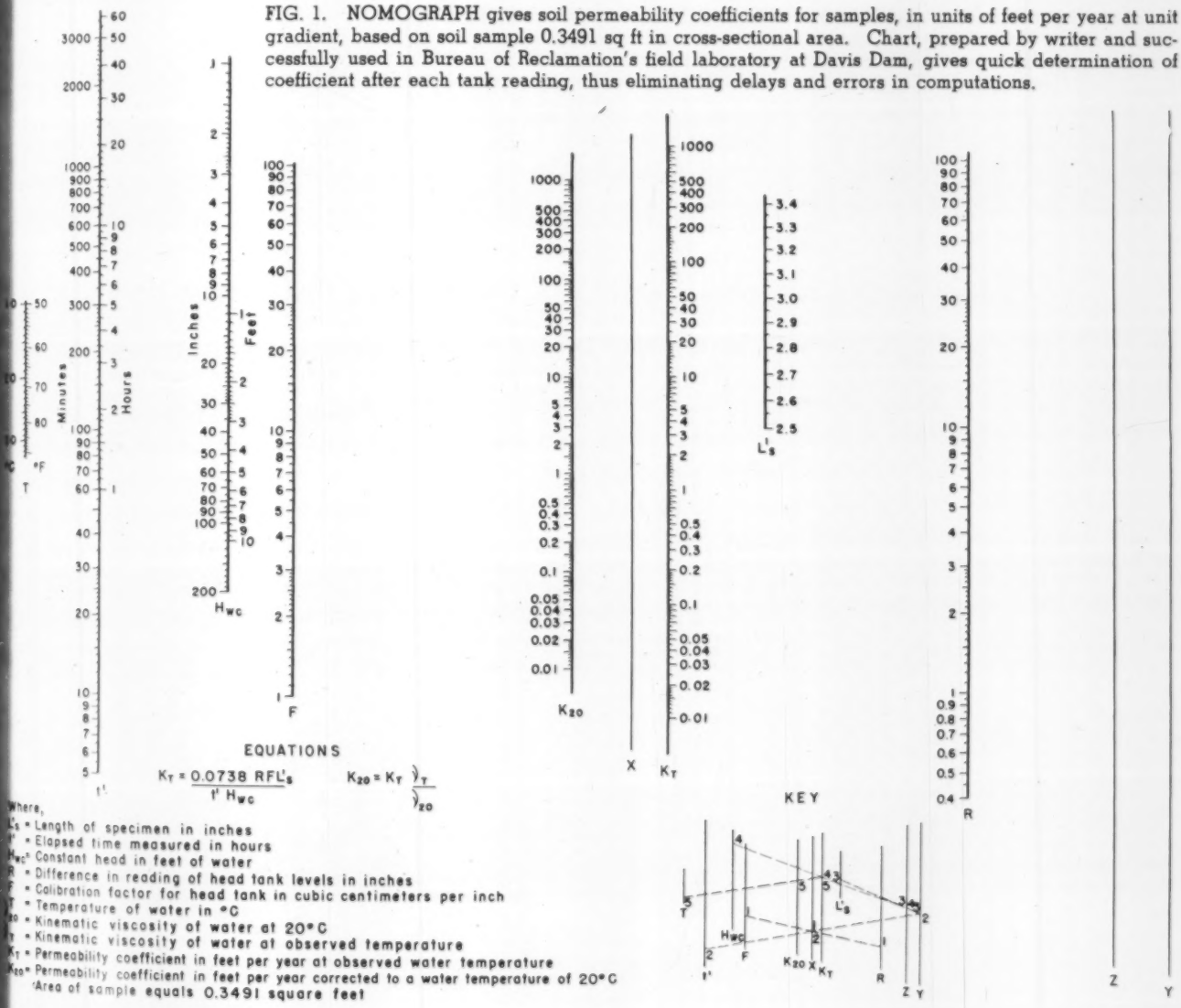

FIG. 1. NOMOGRAPH gives soil permeability coefficients for samples, in units of feet per year at unit gradient, based on soil sample 0.3491 sq ft in cross-sectional area. Chart, prepared by writer and successfully used in Bureau of Reclamation's field laboratory at Davis Dam, gives quick determination of coefficient after each tank reading, thus eliminating delays and errors in computations.

Where,
L'_s = Length of specimen in inches
t' = Elapsed time measured in hours
H_{wc} = Constant head in feet of water
R = Difference in reading of head tank levels in inches
F = Calibration factor for head tank in cubic centimeters per inch
T = Temperature of water in °C
γ_{20} = Kinematic viscosity of water at 20°C
γ_T = Kinematic viscosity of water at observed temperature
K_T = Permeability coefficient in feet per year at observed water temperature
K_{20} = Permeability coefficient in feet per year corrected to a water temperature of 20°C
*Area of sample equals 0.3491 square feet

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brated glass head tank which can be readily raised or lowered to suit the permeability characteristics of the soil. Several head tanks, ranging in diameter from 20 to 60 mm, are employed to provide additional flexibility. Selection of the size to be used is based on the quantity of flow through the sample. The quantity of flow, time between observations, and water temperatures are measured in the course of the test. Each test is continued until the permeability coefficient approaches a constant value. The basic equations and notation are shown in Fig. 1. The original chart is 16 × 18 in.

In the Davis Dam laboratory, a black-line print of the chart, the same size as the original, is mounted with clear Glyptal on a piece of sheet cork. A 24-in. transparent straightedge is used as an interceptor in reading the scales. A sharpened pin stuck through the chart into the cork marks the points and serves as a guide for the straightedge. The key on the chart indicates the proper order for using the scales.

Advantages of this method of computation are: (1) Elimination of some sources of error, (2) saving in time, and (3) need for less skilled personnel.

The chart provides a correction for viscosity and thus eliminates an error that may amount to 30 or 40 percent under the variable temperatures of a field laboratory. Reference to viscosity tables is unnecessary in making this correction since the last step on the nomograph takes care of the matter. In the past a correction for viscosity has not been part of the Bureau's procedure.

The nomograph also eliminates many errors resulting from misplaced decimal points in slide-rule or calculating-machine computations. It also saves time by eliminating the necessity of searching for the position of the decimal point after the significant figures have been derived.

Since the nomograph can be relied on to give a quick determination of the permeability coefficient after each head-tank reading, the technician can readily decide when a test set-up should be dismantled, thus eliminating the delay that results when it is necessary to wait for the completion of office computations.

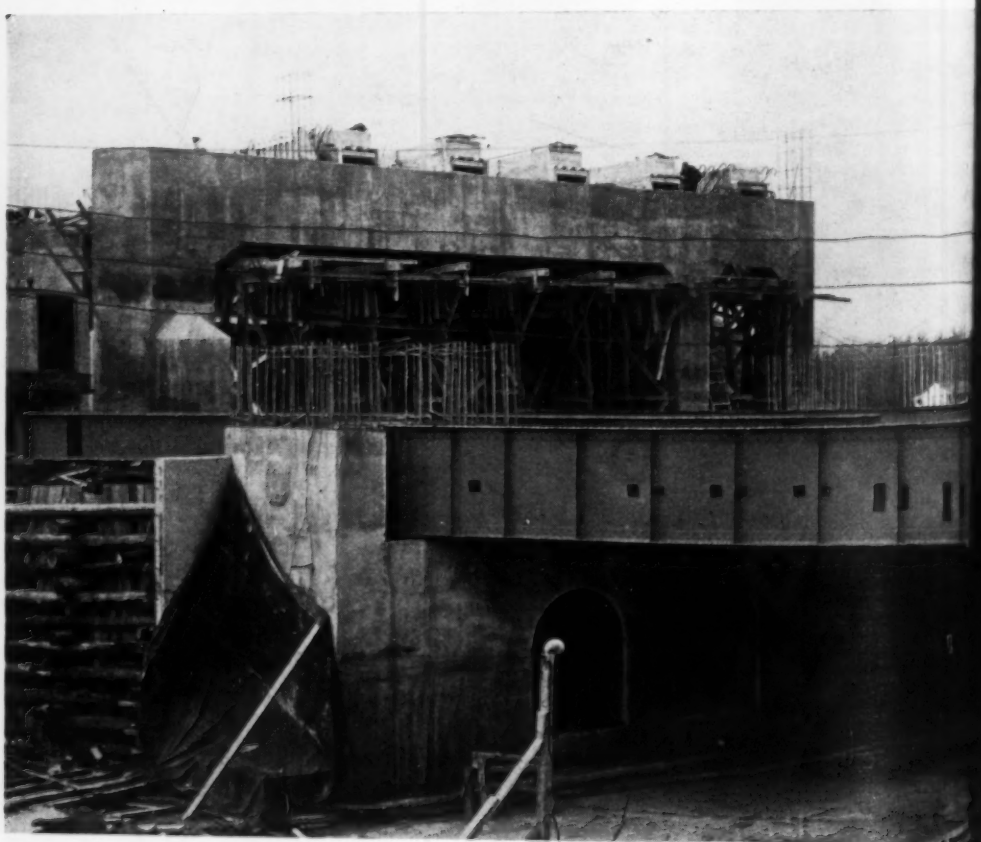
With the aid of the nomograph, tests can be completed and results determined by technicians in subprofessional grades after a brief training period.

The chart has been set up to give readings in units of feet per year at a unit gradient. It is based on a soil sample with a cross-sectional area of 0.3491 sq ft. Readings in units of centimeters per second for any cross-sectional area of sample can be obtained directly by laying off an additional scale on the K_{20} line. To determine the starting point for laying off the new scale, first compute the coefficient for a set of data by ordinary methods. Then go through the steps on the chart in accordance with the key. The intercept of the K_{20} scale indicates where the computed value should be plotted. The new scale can then be laid out as a log scale using the same modulus as appears on the present scale.

Work on the Davis Dam Project is under the direction of the Bureau of Reclamation, headed by Commissioner Michael W. Straus, Washington, D.C. Walker R. Young, M. ASCE, is chief engineer with headquarters in Denver, and E. A. Moritz, M. ASCE, is regional director of Region 3, with headquarters in Boulder City, Nev. H. F. Bahmeier, Assoc. M. ASCE, is in charge of construction of the Davis Dam Project for the Bureau of Reclamation and H. E. Williams, M. ASCE, is project manager for the contractor, The Utah Construction Co. The writer is in charge of the materials laboratory and the installation of technical testing apparatus at Davis Dam.

Virginia Constructs Triple-Decker Rail and Highway Grade Separation

MASSIVE MILLION-DOLLAR three-level underpass-overpass is being constructed by Virginia Department of Highways near Norfolk. Top level of structure will carry U.S. 13 with U.S. 460 and State Route 166Y on lower level. Passing over steel beams shown exposed at center level will be double-tracked main line of Norfolk & Western Railway and a connecting highway. Structure will tower nearly 50 ft from lowest to highest point. Low-level clearance will be 14 ft, second-level clearance 22.6 ft. Triple-level grade separation will complete 14-mile four-lane bypass around city of Norfolk built to relieve seaside traffic congestion in area. See artist's conception of completed structure, December 1947 issue of CIVIL ENGINEERING, page 19.



... THE READERS Write

Graphic Presentation for Solving Cubic Equations

To the Editor: The February issue of Civil Engineering carried a graphic solution of a cubic equation by William R. Davis, with a specific problem of $x^3-11.52x+9.61=0$.

The solution seems to be too much involved with the intermediate calculations. I shall show how it may be solved by a graphic presentation I use not only for cubic equations but for higher powers—even to the $^5/_2$ power.

The basic principle is to resolve the equation into two simultaneous equations equated to y, of which one equation is of the first degree. Plotting these equations gives the value of x as the point of intersection. Increasing the value of the x-axis subdivisions on a decimal unit basis makes it possible for an ultimate solution with any desired decimal points.

The following procedure gives the method of solution and three tables.

In the specific problem, $x^3-11.52x+9.61=0$, rewrite equation

$$x^3=11.52x-9.61=y$$

$$\left.\begin{aligned} y&=x^3\\ y&=11.52x-9.61 \end{aligned}\right\}\ \text{simultaneous equations}$$

Plot these equations, and the point of intersection will be the value of $-x$.

	x^3		$11.52x$	-9.61	$=y$
If $x=1.00$	1.000	$=$	11.520	-9.61	$=1.9100$
0.90	0.729	$=$	10.368	-9.61	$=0.7580$
0.89	0.704969	$=$	10.2528	-9.61	$=0.6428$

It will be noted that Table I gives a value of 0.89681; Table II a value of 0.896812; and Table III a value of 0.8968125.

I stopped at Table III, because the difference between the x^3 of 89,675 to 89,685 indicates that the x^3 curve is practically a straight line. It would have been possible to stop at Table I by checking the curvature of the x^3 curve by spot checking with the cube of 89,681.

Check proof:

$$x^3-11.52x+9.61=0$$
$$0.72128-10.33128+9.61=0$$

N. A. Carle, M. ASCE

Seattle, Wash.

TABLE I. THE VALUE OF x LIES BETWEEN 0.89 AND 0.90—NEARER 0.90

	x^3	$=$	$11.52x$	$-$	9.61	$=$	y
If $x=0.899$	0.7266		10.35648		9.61	=	0.74648
0.898	0.7242		10.34496		9.61	=	0.73496
0.897	0.7217		10.33344		9.61	=	0.72344
0.896	0.7193		10.32192		9.61	=	0.71192
0.895	0.7169		10.31040		9.61	=	0.70040
0.894	0.7145		10.29888		9.61	=	0.68888

TABLE II. THE VALUE OF x LIES BETWEEN 0.896 AND 0.897—NEARER 0.897

	x^3	$=$	$11.52x$	$-$	9.61	$=$	y
If $x=0.8970$	0.7217		10.333440		9.61	=	0.723440
0.8969	0.7215		10.332288		9.61	=	0.722288
0.8968	0.72125		10.331136		9.61	=	0.721136
0.8967	0.7210		10.329984		9.61	=	0.719984

TABLE III. THE VALUE OF x LIES BETWEEN 0.8968 AND 0.8969—NEARER 0.8968

	x^3	$=$	$11.52x$	$-$	9.61	$=$	y
If $x=0.89675$	0.72113		10.330560		9.61	=	0.720560
0.89680	0.72125		10.331136		9.61	=	0.721136
0.89685	0.72137		10.331712		9.61	=	0.721712

x^3 for values from 0.8967 to 0.8970 is nearly representative of a straight-line curve. $11.52x-9.61$ is straight-line curve. For additional decimal points additional values are added. The intersection of these curves plotted shows $x=0.8968125$.

Survey Shows Progress of China's Water Plants

To the Editor: There is no denying the fact that China suffered more than most countries during the recent war. She needs more time and money for rehabilitation and reconstruction than any other country. However, during the two and a half years that have passed since the surrender of Japan, China has been endeavoring to carry on her program of reconstruction under most difficult conditions. A brief investigation of the water plants in China, exclusive of Formosa, the new province, is indicative of the progress being made.

Early in 1947 the Ministry of Interior of the Republic of China sent questionnaires to various water plants for a comprehensive survey of the situation. Replies indicated that 52 out of 70 plants reporting were in operation, while the remaining 18 plants still were under construction. The questionnaire covered such factors as population served, average total daily consumption, average daily consumption per capita, percentage of water unaccounted for, size and mileage of mains, percentage of meters installed, chemicals used, etc.

Replies indicate that the population served by water plants averages only about 39.2 percent of the total population concerned. This, however, does not mean that the rest of the people are thirsty. They have their private wells or take water directly from nearby rivers. From 27 comparatively reliable reports, an average per capita consumption of 19 gal is shown, with the 13 big cities reporting an average of 28.2 gal and the 14 small cities an average of 10.7 gal.

Figures indicate that the maximum daily consumption ranged from 107 to 243 percent of the average daily consumption, with an average ratio of 143 percent. Maximum hourly consumption ranged from 119 to 767 percent of the average daily consumption, with an average ratio of 321 percent.

According to data submitted by 23 water plants, the amount of water unaccounted for ranged from 2 to 60 percent of the intake, with an average of 27 percent. The older the plant, the higher the percentage of water unaccounted for.

Construction costs, based on findings from 14 reports, average $580,000 in American money per million gal of water. Cost of construction shows a wide range—from $30,000 to $1,160,000 per million gal of water. This range may be explained by the facts that the inflation of market prices has made it difficult to determine present costs and that the difficulties of inland transportation make plant costs vary in different localities.

Seven plants submitted detailed reports regarding their distribution systems. These indicate that the tonnage of mains per mgd is from 915 to 2,730, with an average of 1,650 tons per mgd.

John Penchang Lo, Jun. ASCE

Nanking, China

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Erosion Is Not a Dominant Factor in Flood Control

DEAR SIR: Some metropolitan papers have run cartoons and other features showing millions of acres of soil ruined by erosion and the whole Mississippi Valley washing down the river. It is often implied that prevention of erosion on farms will help prevent floods. It is true that good, simple farming practices, such as crop rotation and strip farming, will prevent in some measure the washing of soil into flood control dams, the only real solution to the flood problem. The layout of strips is so simple that a farmer with a carpenter's level or, at most, a Locke level can do a successful job.

Prof. J. B. R. Dickey, extension agronomist of the Pennsylvania State College, had an article in the *Pennsylvania Farmer* for December 13, 1947, entitled "Floods and Flood Control," excerpts from which are quoted here with his permission. It shows why the Lewis and Clark expedition into the Northwest ran into a Mississippi River flood [see box, page 22, of November 1947 CIVIL ENGINEERING] which temporarily stopped it, before any of the forests were cleared or the land plowed in the Plains States. The excerpts follow:

"Forest cover and grass sods have always been considered the best natural means of holding back run-off water and getting it into the soil. However, in the case of our biggest recent flood, that of St. Patrick's Day, 1936, practically all of the flood water came out of the wooded, mountainous areas as a result of widely extended warm rains melting and bringing out a heavy accumulation of snow. The fields were already largely bare of snow and the water was comparatively clear. The disastrous floods around Sinnamahoning and around Honesdale a few years later, as well as the West Branch Valley flood in the spring of 1946, occurred in early summer, as a result of continued heavy rains over a rather large area. Practically all the water in each case came from sections where there are more woods and sod, and less plowed land, than anywhere else in the state. These were the sort of floods which washed out bridges, swamped the towns and farms on the lower land and did tremendous damage.

"When it rains long enough and hard enough, the soil, even under woods or sod, gets so saturated that it can hold no more. A tremendous amount of water must be got rid of through the streams and rivers. When the ground is frozen, the water cannot soak in. Nearly all of it must run off over the surface, regardless of the sort of cover.

"During the Sinnamahoning flood, which occurred in July 1942, an average of over 7 in. of rain was recorded at three widely separated weather stations in less than 24 hours. Unofficial figures were reported of 15 and even 20 in. for this storm, which covered an area of over 500 sq. miles and established a record for northeastern United States.

"Fortunately about half the water went down the upper reaches of the Alleghany River and the other half into the Susquehanna by way of Sinnamahoning Creek. If all of it had fallen in one watershed, one can hardly conceive what it might have done. The ground on the lower slopes of some wooded hills became so full of water that the soil slumped and tremendous springs gushed out of the hillsides where none had been before.

"At the time of the Johnstown Flood, May 30 to June 1, 1889, an average of about 8 in. of rain fell all over the mountain area of Pennsylvania. During the flood of 1936 the average for the whole state was 6.84 in. in two days, while the Williamsport-Lock Haven flood of May 28, 1946, was caused by a mere 4.43 in., mainly in the mountains north of the West Branch of the Susquehanna. In such cases man-made efforts to stay the waters through farm practices seem negligible save in so far as damage to his own and nearby property are concerned."

JOHN R. HASWELL, M. ASCE
State College, Pa.

Says Plane Sections Are Not Plane After Bending

TO THE EDITOR: Many papers on plastic bending, bending of composite beams, and similar subjects are introduced by the statement that the "assumption" is made that "plane sections remain plane after bending."

The principle which is actually involved is that strains in the direction of the beam axis vary linearly across any section. (In a curved beam the strain multiplied by the distance to the center of curvature varies linearly.) This is no assumption; it is a very accurate approximation based on the fact that any other strain distribution persisting along an appreciable length of the beam would build up grotesque deformations. In the vicinity of loads, changes of section, or other disturbances, the approximation may be less accurate, or very bad, but elsewhere there is no need to apologize for it.

There is no need to specify that sections remain plane. Nearly all sections warp under shearing stress; the essential fact is that adjacent sections warp similarly.

Fig. 1

In concluding it may be instructive to consider a rectangular cantilever beam, made of rubber, cemented to the face of an iron block (Fig. 1). Throughout most of the length of the beam, cross sections are moderately warped into an S-shape by shear; the stresses are readily calculated with great accuracy by dividing the moment by the section modulus. At the face of the block, the only section of beam to remain plane, the stresses are very difficult to calculate, and there are known to be considerable stress concentrations.

D. B. HALL, Assoc. M. ASCE
Baltimore, Md.

Suggests Use of Numerical Procedure in Computations

TO THE EDITOR: The recommendations for economic proportioning of variable-section columns made by Ross Laurenson and R. V. Bremer in their article, "Critical Collapsing Load for Columns of Variable Cross Section," in the April issue are of considerable interest, and their tables represent many hours of computation.

For specific cases not well approximated by their tabulated values, use can be made of the method presented in the paper, "Numerical Procedure for Computing Deflections, Moments, and Buckling Loads," by N. M. Newmark, M. ASCE, in Vol. 108 of the ASCE TRANSACTIONS (page 1161). On the basis of Laurenson and Bremer's results, it would seem that some pattern of variation of section should yield a maximum ratio of strength to weight. Newmark's numerical procedure can be used to approach the ultimate solution more closely.

C. J. POSEY, M. ASCE
Director, Rocky Mountain Hydraulic Laboratory
Allenspark, Colo.

Offers Simple Solution to Trisection of Angle

Although discussion of the absorbing problem of splitting the angle (into three equal parts) was virtually closed in the April 1948 issue of CIVIL ENGINEERING *(page 45) by James B. Goodwin, who stirred up the dying embers of this age-old teaser in his article in the January 1948 issue (page 39), the following solution deserves special mention. An unusually accurate and yet extremely simple procedure is offered by Francis E. Simpson in his M/3 method. The "why" of the accuracy of the solution is perhaps its most intriguing facet.—Editor*

TO THE EDITOR: I have read with great interest the recent articles on angle trisection appearing in CIVIL ENGINEERING and now wish to present, for the first time, my own version of the solution of this famous problem, keeping in mind always the admonition that it has been proved impossible of solution by Euclidean geometry.

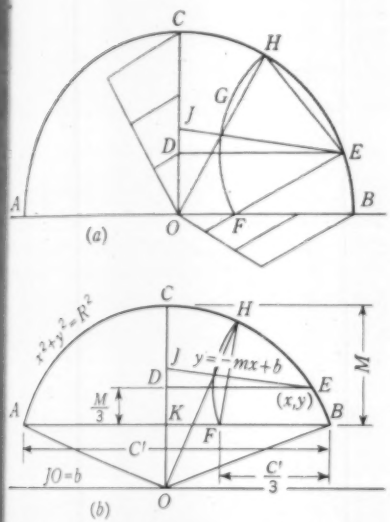

Fig. 1. Angle HOB equals one-third AOB.

My method, developed only after many long and tedious calculations, is both exceedingly simple and surprisingly accurate. It holds for all angles so closely that, for a radius of 6 in., the error of closure in inches for the third point of a half circle is only about 0.01 in.; for an angle of 120 deg, about 0.005 in.; and for 90 deg, 0.0036 in. These represent errors of 1 in 500, 1 in 700, and 1 in 900, respectively, which border on precision for ordinary drafting room practice. The position of the center E of the trisecting arc on the arc of the given angle is readily obtained by writing the equation of the given circle, $x^2 + y^2 = R^2$, the equation of the bisector of the trisecting arc, $y = -mx + b$, and solving simultaneously for y. Painstaking calculations for angles selected at random will fix the position of this center unbelievably close to the point determined by one-third the height of the middle ordinate.

Consequently, it may be stated without much fear of controversion, that the trisection of an angle by Euclidean geometry only, may be accomplished as follows: Trisect the middle ordinate CO (Fig. 1*a*) or M (Fig. 1*b*) in the orthodox fashion. Trisect, likewise, the radius OB (Fig. 1*a*) or the half chord KB (Fig. 1*b*). Project the lowermost one-third point D, of each middle ordinate (parallel to AB) to point E, the center of the trisecting arc. With E as a center, and radius EF (F being the innermost one-third point of the half chord OB (Fig. 1*a*) or KB (Fig. 1*b*), strike arc FG, cutting ACB at H. The point H is the one-third point of ACB, and angle HOB is one-third angle AOB.

FRANCIS E. SIMPSON, M. ASCE
Detroit, Mich.

Cites Need for Simplifying International Laws for Registration

TO THE EDITOR: The National Council of State Boards of Engineering Examiners Committee on Registration by Endorsement, of which I am chairman, is appealing to engineers in other countries, especially Canada and Latin America, to join in a sincere effort to emphasize the unity of the engineering profession and to eliminate or minimize the barriers to international practice. If the registration laws of any state or country contain any discriminatory features, or any features tending to create needless barriers against the practice of qualified men, they should be corrected.

Upon examining our own registration laws in the various states as they affect the possibility of practice by qualified engineers of other countries, we find in some of our state laws restrictions or requirements that are barriers to international practice. The only satisfactory rule is the Golden Rule. We want to make our laws the model for other countries to follow, and we want to ask the engineers of other countries to match us in fairness and courtesy.

We are glad to find that 38 of the 48 states have no restrictions against the registration of qualified engineers who are citizens of other countries. Three of the states (North Carolina, South Dakota, and Wyoming) require United States citizenship as a prerequisite for engineering registration. Five others (Nevada, New Jersey, New York, Pennsylvania, and Virginia) specify United States citizenship or declaration of intention to become a citizen. Mississippi and Minnesota admit citizens of Canada on the same basis as United States citizens. New York State offers a temporary practice permit, which is renewable annually, to qualified engineers who are citizens of other countries.

Ability to speak and write English is specified by Colorado, Minnesota, Mississippi, New Jersey, and North Carolina. As a rule, this requirement does not present a barrier to foreign engineers seeking to practice in this country. We have to remember, however, that a reciprocal requirement in foreign countries would often prove a real difficulty to United States engineers.

In our campaign for international good will and cooperation, we should show our sincerity and good faith by seeking to correct any features in our own laws that appear to be unnecessary or discriminatory barriers to international practice.

The data summarized above are taken from the *Digest of State Laws Governing the Practice of Professional Engineering and Land Surveying*, compiled and published in 1947 by the N.C.S.B.E.E. Any corrections or additional information on the subject should be communicated to the committee.

D. B. STEINMAN, M. ASCE
Chairman, N.C.S.B.E.E.
Committee on Endorsement

New York, N.Y.

Long History of Brooklyn Bridge Recalled by Engineer

TO THE EDITOR: In connection with the sixty-fifth anniversary of the dedication of Brooklyn Bridge, on May 24, it occurs to me that my recollections of the many years that I have been on the engineering inspection of this bridge will be of interest. My researches in the masses of old prints and photographs, revealing the bridge in its earliest forms, make me value the pictures somewhat as the mother of a successful citizen treasures her photographs of junior in his knee pants and the garb of earlier days.

The Brooklyn Bridge, merely a prosaic pile of serviceable masonry and steel to the many thousands who cross it daily on their way to and from work, is a lady of beauty and romance with a very distinct past. There is romance in the structure, and every engineer-in-charge since the bridge was opened has felt it for every one of them has kept a complete scrapbook of newspaper clippings relating to the bridge and its glorious history.

It was the first bridge across New York's busy East River. Long regarded

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as the Eighth Wonder of the World, and still famous, the bridge continues as a vital link between Brooklyn and Manhattan.

In this year of the Golden Jubilee anniversary of the City of New York, the Brooklyn Bridge assumes a new significance. Opened fifteen years before the city was consolidated, it has bound together the boroughs of Brooklyn and Manhattan in commercial, municipal and cultural progress. Later this year, the Brooklyn Engineers' Club will erect a fitting bronze memorial plaque, at a conspicuous location on the Brooklyn Tower (above the promenade level), to publicly record the service of Emily Warren Roebling, the wife of Col. Washington A. Roebling (builder of the bridge), on the project.

THEODORE BELZNER, Affiliate, ASCE
Brooklyn, N.Y.

Describes Early Irrigation Structures in San Antonio Area

TO THE EDITOR: Irrigation has been employed in the San Antonio area for hundreds of years, and one structure in use today has seen at least two centuries of service. Other irrigation structures dating back to the early eighteenth century were abandoned after many generations of service.

The Spaniards realized the need for irrigation late in the seventeenth century when they were establishing forts and missions in Texas in an attempt to Christianize the Indians and lay the groundwork for permanent settlements. The missions had to be self supporting, and it was necessary to teach the Indians, who had never farmed, to sow and reap. San Antonio, which soon became the principal center of mission activity in Texas, had one of the earliest and largest irrigated areas in the state.

The Spaniards were skilled in irrigation, as the Gothic and Moorish systems of irrigation had met and been consolidated in Spain. As a matter of fact, the science had such an important place in the Spanish system of conquest that missions and forts were established wherever water was available for irrigation even in localities where irrigation was not necessary.

Following establishment of the Mission of San Antonio de Valero, now the Alamo, on the San Antonio River in 1718, the Alamo Madre Ditch was dug to supply water to the mission and its lands. This ditch, which was six miles long, irrigated about 900 acres. More than a century later, it served as a source of water supply for the defenders of the Alamo.

The San Jose Ditch was built about 1720 to supply water to San Jose Mission and about 600 acres of land, and San Jose became the finest Spanish mission in what is now the United States. Crops of corn, beans, wheat, cotton, sugar cane, vegetables and fruits were raised. The mission had a grist mill which was run by water power, the water discharged by the mill wheel being used to irrigate some of the mission lands. The San Jose Ditch was abandoned in 1860 because of repeated washing away of the loose rock diversion dam across the river.

The Concepcion Ditch, which was constructed about 1729 to irrigate land for the Concepcion Mission, was the largest of the old ditches, and the priests were able to use a boat on its waters for transportation. The structure was abandoned in 1869 because of the removal of the diversion dam which caused repeated floods in the growing city of San Antonio.

Last of the mission ditches, the Espada Ditch took water from the west side of the San Antonio River by means of a diversion dam, which was built on a natural ledge of rock extending across the river. The ditch crossed Piedras Creek on a massive stone aqueduct, probably the only one of its kind in the United States. After two hundred years of service, it is still in use today.

The methods used by the early builders in constructing their ditches and irrigation structures must be left largely to conjecture as little information is available on the subject. For laying out the grade of ditches, an A-frame in the shape of an equilateral triangle with a plumb line hanging from the apex may have been used, but it is more likely that water was turned into the ditch from time to time to check the grade. Ditches closely followed the grade contour in order to avoid the necessity for large cuts and fills. Dirt was moved on hides dragged by oxen, hauled in carts, or transported manually. In places where steel implements were lacking, digging was done with paddle-like wooden spades, walnut being a favored wood for such shovels as the dirt did not stick to the wood. Diversion dams were sometimes made of mortar and stone, but usually consisted of loose rock and brush and required constant repair. The mission Indians were the laborers, the priests were the foremen and engineers, and there was usually a small detachment of soldiers to guard the workmen.

Although the Spanish colonial system failed, the Spaniards solved the problem of living in arid and semi-arid climates by digging irrigation ditches and bringing water to the land. The city of San Antonio now covers most of the mission lands and fields, but there are still traces of the early irrigation systems which had such an important part in holding Texas for the Spaniards for more than a hundred years.

E. L. HARRINGTON, Assoc. M. ASCE
Associate Professor of Civil Engineering, Texas A. & M. College
College Station, Tex.

ESPADA DIVERSION DAM (left), constructed by Spaniards in San Antonio area about 200 years ago, is one of earliest irrigation structures in United States still in use. Photograph at right shows massive stone aqueduct, which carries Espada irrigation ditch across Piedras Creek.

SOCIETY NEWS

California Sections Hear ASCE President and Secretary at Fresno Conference

YOUNG ENGINEERS MUST support the profession, so that it will be in a position to give the public economically sound projects, ASCE President R. E. Dougherty said in an address at the recent two-day Fresno Conference of California Local Sections—Los Angeles, Sacramento, San Diego, and San Francisco. Following his talk at the Friday night dinner meeting before an audience of 400 Section members, Student Chapter representatives, and their lady guests, President Dougherty presented prizes in the student paper competition.

First award of $25 went to Charles Forester, of the California Institute of Technology Student Chapter, for his illustrated paper on the Los Angeles traffic plan. Mr. Forester, for five years an Army Air Force pilot, is now president of the junior class at the Institute. Close runner-up in the contest was Marvin A. Larson, of the Stanford University Chapter, who received second prize of $15 for his paper on "Permafrost."

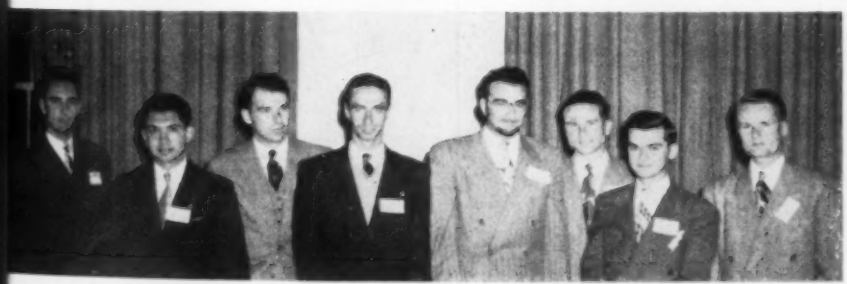
Other features of the Friday program included an inspection trip to Friant Dam, part of the Central Valley Project under construction by the Bureau of Reclamation. A side trip to the Pine Flats damsite on the Kings River showed excavation well under way on this Army Engineer flood control and storage project.

Of interest to the 400 engineers making the inspection trip to Friant Dam were special "Data for ASCE Field Trip" sheets that had been assembled by the Bureau of Reclamation for the use of guides conducting the tour. The data were presented in the following form:

I. FRIANT DAM

1. Dimensions of dam
   - *a.* Length 3,488 ft
   - *b.* Maximum height 319 ft
   - *c.* Volume of concrete 2,135,000 cu yd
   - *d.* Storage April 23, 180,805
   - *e.* Release April 23, 1,600 cfs About 2,500 cfs inflow to reservoir
2. Cost; direct construction costs $20,230,000
3. Drum Gates
   - *a.* Elevation; open 560, closed 578, height 18 ft
   - *b.* Additional storage; 80,000 acre-ft
   - *c.* Operation; hydraulic, through 57-in. butterfly valve; lower with regulating valve internal differential 24 in.
   - *d.* Dimensions; 3 gates each 100 ft long, weight 250 tons each.
4. Outlet Valves
   - *a.* River Outlet
     1. 4—96-in. hollow jet valves (2 temporary 84-in. needle valves)
     2. Bottom of intake El. 375, outlet valve El. 330
   - *b.* Madera Canal Outlet
     1. 2—86-in. needle valves, internal differential balanced
     2. El. at center of valve: 446
   - *c.* Friant-Kern Canal Outlet
     1. 4—96-in. hollow jet valves
     2. El. at center of valves: 464
   - *d.* Stilling pool—Friant-Kern Canal
     1. Length of pool 440 ft
     2. Parabolic section below valves, drop of 10.92 ft, vertical rise of 5.67 ft
     3. Vacuum process used on face of concrete
5. Power development
   1. Proposed 1,000 kw. Principally for camp use.
6. Lake Millerton
   - *a.* Capacity, 520,500 acre-ft
   - *b.* Length, 16 miles
7. Historical
   - *a.* First pour—July 1940, finished concrete 1942
   - *b.* First irrigation season Madera, 1944
   - *c.* Reservoir spilled in 1945 and 1946

ASCE PRESIDENT R. E. DOUGHERTY (right) presents first prize to Charles Forester, of California Institute of Technology Student Chapter, in student paper competition at recent Fresno Conference. Board of judges consisted of President Dougherty, chairman; ASCE Vice-President John W. Cunningham; and M. J. Shelton, president, San Diego Section.



STUDENT CHAPTER OFFICIALS AND CONTESTANTS in student paper competition are photographed at Student Conference, held during recent Fresno Conference of Local Sections in California. Left to right are Donald King and Ismael Ismen, chairman and timekeeper, Stanford; Marvin A. Larson, Stanford, second prize; Sol Goldberg, University of California, fourth prize; Elmo di Ricco, University of Nevada, sixth prize; Charles Forester, California Institute of Technology, first prize; Thomas Ford, Jr., University of Santa Clara, third prize; and Walter Clark, University of Southern California, fifth prize.

Similar data sheets had been prepared for the Madera Canal, Friant-Kern Canal, Little Dry Creek Siphon, Big Dry Creek Siphon, Fancher Creek Overchute, Kings River Siphon, and the Piedra Road Bridge.

During the Saturday morning technical session, California State Engineer Edward Hyatt and Samuel B. Morris, chief engineer of the Los Angeles Department of Water and Power, explained the state's plan to make maximum use of its water supply. In a discussion of their papers, A. M. Rawn, chief engineer for the Los Angeles County Sanitation Districts, declared that the short water supply in the southern part of the state could be augmented by reclamation of sewage water for irrigation and domestic use. However, he pointed out, there are technical, chemical, legal, and financial obstacles that must be overcome before it can be used even for irrigation purposes.

Diversion of water from the Colorado River Aqueduct to San Diego by means of a new pipeline was described by Fred C. Scobey, senior irrigation engineer for the U.S. Department of Agriculture. Reporting on a series of flow-capacity tests of this conduit, Mr. Scobey stated

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that as much as 95 cfs has been diverted in recent tests. ASCE Director Julian Hinds, chief engineer of the Metropolitan Water District of Southern California, commented on the scope of the tests and said the conduit gives indication of a greater capacity than that for which it was designed.

The principal speaker at the Saturday luncheon meeting was ASCE Executive Secretary William N. Carey, who urged his audience to participate in the solution of public problems through their respective technical societies. Speaking on "Engineers and Politics," Colonel Carey stated that "the engineering profession is free from any suspicion of political motivation." He pointed out the obligation of California engineers to take direct part in working out state and local problems, and discussed the contributions made by the engineering profession on the national and international levels through the medium of Engineers Joint Council.

In a discussion of the recently amended California Registration Act, at the afternoon session, members of the Registration Board commented on weaknesses of the law and proper procedures for making changes in it. Speakers included Paul Jeffers, president of the State Registration Board; L. W. K. Boelter, member of the Board; and Markham Salsbury, chairman of the State Legislative Committee of Engineering Organizations.

A Student Chapter Conference, attended by 130 delegates from eight engineering schools, concluded the technical program. Sponsoring Chapters were those at the University of California, the University of Southern California, the University of Nevada, Stanford University, the University of Santa Clara, and the California Institute of Technology.

Encouraged by the attendance of more than 400 and the success of the program at this first joint meeting of California Local Sections, the group decided to make the conference an annual affair and selected San Diego for its 1949 meeting. The California Conference of Student Chapters will meet at the same time and place.

ASCE Student Chapters Hold Twelve Spring Regional Conferences

KEEN STUDENT CHAPTER interest in professional and Society activities is attested by the success of the student conferences, sponsored by Chapters in all parts of the country during the past spring season. Eleven recent conferences on a prewar scale—the New England, Metropolitan, Philadelphia Section-Lehigh Valley, Maryland-District of Columbia, North Central, Mid-Western Mid-Continent, Texas, Southwestern, Rocky Mountain, and Pacific Northwestern Conferences—are reported here. The California Conference is reported in the preceding item.

New England Conference

More than 80 delegates from eleven New England Chapters met at Worcester Polytechnic Institute, Worcester, Mass., on May 8. A feature of the all-day program was the presentation of awards of Junior membership in the Society to three authors of prize-winning papers. Recipients, in the order of award, were J. T. Gumpertz, Massachusetts Institute of Technology; Lester Gaynor, Tufts College; and George A. Burpee, Harvard University. This session, under the chairmanship of W. C. Applegate, president of the host Chapter, was addressed briefly by Rear Admiral W. T. Cluverius, president of W.P.I.

At an open forum on student conference activities, the group heard a report of the past year's accomplishments by Conference Chairman William Fannon, of the University of Connecticut. In a discussion of conference plans for a summer employment program, Don P. Reynolds, assistant to the Secretary of ASCE, told of the experience of other student groups —particularly the Metropolitan Conference.

Four other discussion groups met to consider various career opportunities in civil engineering. These were led by E. W. Fowler, assistant chief engineer of the National Board of Fire Underwriters, on fire-protection engineering; O. G. Julian, structural engineer for Jackson & Moreland, Boston, on construction engineering; Joseph Piacitelli, Thompson & Luckner, on business administration; and G. G. Bogren, of Weston & Sampson, Boston, on sanitary engineering and hydraulics.

The following new officers for the New England Conference were elected: Kirby Weathersby, W.P.I., chairman; Whitney Ferguson, Tufts College, vice-chairman; and Arthur P. Rich, Northeastern University, secretary-treasurer.

The student group attended a joint dinner meeting of New England Local Sections and the Boston Society of Civil Engineers, to which the Worcester Society of Civil Engineers was host (see page 64 of this issue).

Metropolitan Conference

New York University was host to an all-day conference of student delegates from Metropolitan New York Chapters on May 1. Chapters represented were the College of the City of New York, Columbia University, Cooper Union, Newark College of Engineering, New York University, and Polytechnic Institute of Brooklyn.

Dean Thorndike Saville, Prof. D. S. Trowbridge, Faculty Adviser for the N.Y.U. Chapter, and Chapter President Manuel Emanuel, welcomed the students. Four speakers were introduced by Conference Chairman Herbert I. Tyson. A talk by ASCE Vice-President Carlton S. Proctor on the application of engineering talents through the medium of professional organizations was followed by one

PICTURED IN ATTENDANCE at Philadelphia-Lehigh Valley Student Conference are, left to right, V. W. Anckaitis, president of Lehigh Valley Section; Prof. S. T. Carpenter, chairman of Philadelphia Section Committee on Student Chapters; E. S. Noble, president of Lafayette College Student Chapter; Dr. Ralph C. Hutchison, president of Lafayette College; Prof. H. K. Preston, president of Philadelphia Section; and Prof. W. S. Lohr, head of civil engineering department at Lafayette.

on Student Chapter activities by Don P. Reynolds, assistant to the Secretary of ASCE. Other speakers were Dean John J. Theobald, of City College of New York, and Mario G. Salvadori, associate professor of civil engineering at Columbia University, who led a forum on "Horizons in Civil Engineering." The forum centered on engineering teaching and applied mechanics.

Following luncheon on the campus, the group made a conducted tour of the New York University laboratories.

Philadelphia-Lehigh Valley Conference

The tenth annual conference of schools in the Philadelphia and Lehigh Valley Sections, held at Lafayette College, Easton, Pa., attracted 342 representatives of ten Eastern Chapters. Speakers at the all-day conference included E. S. Noble, president of the host Student Chapter; Dr. Ralph C. Hutchison, president of Lafayette College, who gave the address of welcome and spoke on the importance of maintaining a balance between the arts and the sciences; Victor W. Anckaitis, president of the Lehigh Valley Section; Prof. Howard K. Preston, president of the Philadelphia Section; and Prof. Samuel T. Carpenter, chairman of the Philadelphia Section's Committee on Student Chapters, who discussed the background and aims of the conference.

Nine technical papers were presented in a competition for prizes offered by the sponsoring Sections. First prize, consisting of Junior membership in the Society and a cash award of $10, was won by William F. Anderson, of Lafayette College, for his paper on "The Tacoma Bridge Failure and Subsequent Developments in Suspension Bridge Design." Robert B. Whitman, of Swarthmore College, was the recipient of second prize of Junior membership in the Society, for a paper on "The Electric Strain Gage," and honorable mention went to John E. Arnold, of the University of Pennsylvania.

The part played by experience and hard work in the development of a good engineer was emphasized by ASCE Director Joel D. Justin in a talk on "The Qualifications and Duties of the Consulting Engineer." Don P. Reynolds, assistant to the Secretary of ASCE, spoke on the opportunity for public recognition afforded engineers by membership in such organizations as the Society, and an illustrated lecture on Rocky Mountain glaciers, given by Dr. James L. Dyson, of the geology department at Lafayette College, concluded the program.

Maryland–District of Columbia

George Washington University Student Chapter recently was host to the Maryland–District of Columbia Conference in Washington, D.C. This seventh annual meeting brought together more than 100 students from Johns Hopkins University, the University of Maryland, Catholic University of America, and the host Chapter.

A diverse program was presented by the conference executive committee, under the chairmanship of Charles A. Appel and the guidance of Dean Carl Walther, both of George Washington University. The conference, opened by President Ervin Liljgren of George Washington University, featured talks by Dean Walther and ASCE Assistant Secretary E. L. Chandler. Motion pictures of construction projects rounded out the morning session.

Ideal weather added to the pleasure of the afternoon excursion to the Naval Ordnance Laboratory at White Oaks, Md. A banquet brought the group together again in Washington. Toastmaster for the occasion was Dean F. M. Feiker, of the George Washington College of Engineering. Don P. Reynolds, assistant to the Secretary of ASCE, discussed opportunities in the civil engineering field, giving an analysis of the over-all employment situation.

North Central Conference

Representatives from five Student Chapters—at the University of Detroit the University of Michigan, Michigan State College, Case Institute of Technology, and the University of Toledo—attended the North Central Conference at the University of Toledo on May 8.

K. L. DeBlois, engineer of designs for the Lakefront Dock & Railroad Terminal Co., described the new $18,000,000 docks being constructed on the Toledo waterfront for the New York Central and Baltimore & Ohio railroads, emphasizing work done by young engineering graduates on the job. A field trip provided opportunity for inspection of construction work on the project.

In a talk on "Engineering Interest in the Law," which highlighted a dinner meeting, Prof. W. G. Sadler, of the University of Michigan, pointed out many contractural and construction relationships between law and engineering and stressed the importance of a knowledge of these relationships to engineers. Other speakers included S. C. McKee, Contact Member for the University of Toledo, who expressed the interest of the Toledo Section in the group, and ASCE Mid-Western Representative George S. Salter, who discussed the Society's interest in Student Chapter and Junior activities.

Case Institute of Technology will be host to the 1949 conference.

Mid-Western Conference

The Fourth Annual Mid-Western Conference, held at the University of Minnesota on April 16 and 17, was attended by more than 90 delegates from Marquette University, the Illinois Institute of Technology, the University of Wisconsin, South Dakota State College, North Dakota Agricultural College, Northwestern University, Iowa State College, Purdue University, South Dakota School of Mines, the University of Iowa, Rose Polytechnic Institute, and the University of Illinois.

A symposium on "Civil Engineering Opportunities" featured the opening session, with four speakers representing possible fields of opportunity: Col. Walter K. Wilson, Jr., district engineer at St. Paul for the Army Corps of Engineers; H. W. Richardson, executive editor of *Construction Methods;* C. L. Motl, chief maintenance engineer for the

MORE THAN 100 STUDENT CHAPTER MEMBERS in attendance at Maryland–District of Columbia Student Conference, held at George Washington University, visit Naval Ordnance Laboratory at White Oaks, Md.

UNIVERSITY OF ILLINOIS LIBRARIES

PARTIAL GROUP OF STUDENT CHAPTER MEMBERS from eleven engineering schools in Northwestern Section area who attended two-day Mid-Western Conference, held at University of Minnesota. Seated at table are Robert Kenning (left) and Robert Dunn, host Chapter, conference president and conference secretary, respectively.

Minnesota State Highway Department; and William B. Irwin, assistant to the vice-president of the Great Northern Railway Co. Hibbert Hill, hydraulic engineer, Northern States Power Co., spoke on the "Proposed Sea Level Route of the Panama Canal" to an audience of more than 200 at the conference banquet, held in the Coffman Memorial Union.

Saturday morning was allocated to inspection tours to two of the outstanding points of engineering interest in the Twin Cities—the St. Anthony Falls Laboratory and the Twin Cities Sewage Disposal Plant. Dr. Lorenz Straub, director of the Laboratory, conducted the group through it.

At a business meeting, plans were made for the Fifth Annual Mid-Western Conference, to which Northwestern University will be host next April. Conference officers elected are: Bob Disque, Northwestern University, president; Bert Sieck, Iowa State College, first vice-president; and Maurice Nelson, University of Iowa, second vice-president.

Mid-Continent Conference

A two-day conference of Student Chapter representatives from seven engineering schools in the mid-continent area met recently at the University of Kansas, Lawrence, Kans. Schools represented were the University of Arkansas, Kansas State College, the University of Kansas, the University of Missouri, the University of Nebraska, the Missouri School of Mines, and Washington University of St Louis.

In a symposium on Student Chapter activities, representatives from each of the seven Chapters gave mutually helpful information on the operation of their Chapters. Talks by Dr. H. Roe Bartle, chief Boy Scout executive of Kansas City, and ASCE Mid-Western Representative George S. Salter were highlights of the two-day program. C. R. Van Orman, district engineer of the Kansas City office of the Corps of Engineers, discussed the Missouri Basin Plan and flood control on the Mississippi.

The conference selected the Missouri School of Mines as host for the next conference—to be held in October—and Nemo Wilhelms, of the University of Nebraska, as president. Officers of the present conference were: Irvin Barnett, of Kansas State College, president; Firman L. Horn, University of Missouri, vice-president; and Glenn C. Gray, University of Kansas, secretary-treasurer.

Texas Conference

All five engineering schools in Texas were represented at the Texas Conference of Student Chapters, held at Corpus Christi, Tex., April 22–24, in conjunction with the spring meeting of the Texas Section.

Highlight of the meeting for the student group was the traditional Saturday morning breakfast, at which the delegates were guests of the Section. Representatives from each school, selected in preliminary Student Chapter competitions, read their prize-winning papers in a contest for Section awards. First prize of $25 went to Hal Hall, of the University of Texas, and second prize of $15 to Robert Hudson, of Rice Institute. Bob Wright, of Texas A. and M. College, and Joe Stanovsky, of Southern Methodist University, were awarded prizes of $10 each in a tie for third place, and a special prize of $10 was given to I. H. Hale, of Texas Technological College, who placed fifth.

The conference selected Hal Hall as president of the next conference, which will be held in conjunction with the next spring meeting of the Texas Section.

Southwestern Conference

ASCE members in New Mexico and El Paso were host to 110 delegates from five Southwestern Student Chapters at a two-day conference, held in El Paso on May 7 and 8.

Principal speakers at the opening banquet, in a symposium planned to acquaint the students with engineering works and with employment opportunities, were ASCE Director C. Glenn Cappel, New Orleans, La., and ASCE Western Representative Walter E. Jessup. Mr. Cappel urged the engineers to increase their professional strength by affiliation with professional engineering societies. Addressing his remarks chiefly to the students, Mr. Jessup urged them to continue their professional education after college and to obtain membership in the Society at the earliest opportunity.

WINNERS IN COMPETITION FOR SECTION PRIZES at Southwestern Student Conference, held at El Paso, Tex., May 7 and 8, are (left to right): John B. Van Buskirk, University of New Mexico, fourth prize; David C. Haris, of New Mexico State College, fifth prize; Alton Martin, Texas Technological College, second prize; Andrew G. Pickett, University of Arizona, first prize; and Frank A. Smith, Texas College of Mines, third prize.

HEAD TABLE AT ANNUAL JOINT MEETING of Seattle Section and University of Washington Student Chapter, held in conjunction with Pacific Northwestern Student Conference, is shown here. In front row, left to right, are: Roy Tinney, University of Washington Chapter; Robert Currie, outgoing president, University of Washington Chapter; B. P. Thomas and T. H. Campbell, president and secretary-treasurer of Seattle Section; and James Higgins, University of Washington Chapter. In same order, back row, are: John Boils, president of Oregon State College Chapter; Rolf Beck, University of Washington Chapter; Al Williamson, president of Montana State College Chapter; Eric Batchelor, president, Washington State College Chapter; Carl Voeller, president, University of Idaho Chapter; and Richard Bogan, new president of University of Washington Chapter.

On the following day the students were guests of the Texas College of Mines. The program consisted of a talk by George A. Whetstone, professor of civil engineering at Texas Technological College, on "Uniform Flow at Critical Slopes in Open Channels," and a prize paper competition. Contestants were five students, chosen by their Student Chapters in a preliminary competition. First prize, a slide rule, went to Andrew G. Pickett, of the University of Arizona, for a paper on "Water Resources of the Tucson Area." Alton Martin, of Texas Technological College, received second prize; Frank A. Smith, of the Texas College of Mines, third prize; John B. Van Buskirk, of the University of New Mexico, fourth prize; and David C. Haris, of New Mexico State College, fifth prize.

Following a luncheon, at which Mr. Jessup presented the prizes, a caravan of cars carried the group on an inspection trip to the American Dam, the El Toro plant of the Southwest Portland Cement Co., and the El Paso water and sewage treatment plants.

The group voted to make the conference an annual event and decided upon Albuquerque, N.Mex., as the next meeting place. The New Mexico Section and the University of New Mexico Student Chapter will be joint hosts.

Rocky Mountain Conference

Under sponsorship of the Colorado Section, the Rocky Mountain Conference of Student Chapters met at Colorado A. and M. College at Fort Collins, Colo., on May 1. The attendance of 100 included delegates from the University of Wyoming, the University of Colorado, and Colorado A. and M. College, and a number of guest students from the University of Denver College of Engineering.

Student Chapter activities in the area were reviewed at the opening session by A. J. Ryan, president of the Colorado Section, and ASCE Western Representative Walter E. Jessup discussed the EJC report, "The Engineering Profession in Transition." The students and Section members then had a joint luncheon with 100 or more engineering teachers in attendance at the Rocky Mountain meeting of the American Society for Engineering Education. ASCE Executive Secretary William N. Carey, who was making a tour of Western Local Sections, addressed the joint gathering on "Engineers and Politics." In his talk, Colonel Carey urged engineers to take a more active part in public affairs, pointing out their qualifications for service at community and national levels.

The student group devoted the afternoon to an inspection tour of the four rolled earth dams that form the Horsetooth Reservoir, regulating the Big Thompson Trans-Rocky Mountain Irrigation Project which is being built by the Bureau of Reclamation.

Pacific Northwestern Conference

About 65 delegates from Student Chapters at the University of Idaho, Washington State College, Oregon State College, Montana State College, and the University of Washington attended the recent Pacific Northwestern Conference, to which the University of Washington was host.

Highlight of the program, which centered about discussion of Student Chapter activities, was attendance at the annual joint dinner meeting of the Seattle Section and the University of Washington Student Chapter, held in Seattle in the evening. In the annual prize paper competition, three University of Washington students—J. J. Higgins, R. B. Beck, and E. R. Tinney—tied for first place, and were awarded Section prizes of $10 each.

ASCE Committee Plans to Aid Young Engineering Teachers

NOTING THAT DURING the past two years many young teachers with incomplete qualifications have been added to university staffs in order to care for tremendous increases in the number of students, the ASCE Committee on Engineering Education, with the cooperation of a corresponding committee of the American Society for Engineering Education, has been studying ways and means of facilitating necessary practical experience for these young teachers. The Committee believes it obvious that such men would be better teachers if they possessed some practical engineering experience.

Two steps appear to be necessary for facilitating this project. The first is cooperation by employers of engineers so as to make employment available to young engineering teachers during summer months, and, if possible, part-time during the school year. The second is cooperation by university administrators, particularly deans and department heads, to release young teachers from teaching duties during the summer months so that they may be able to acquire necessary practical experience in their major fields.

The Committee believes that such projects would benefit all concerned: the employer, because he would secure part-time service from well-trained young men who would be especially alert because of the object of such employment; the school, because of the added authority the teacher will acquire from personal practical application of the principles he teaches; and the employee-teacher, for obvious reasons.

A circular letter to this effect has been sent by the Committee to all Local Sections, with copies going to the deans of colleges and universities that maintain engineering curricula.

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Highway Engineer Shortage Is Laid to Low Pay and Insecurity

To advance the interests of highway engineers, the ASCE Highway Division's Committee on Developments in Highway Engineering and Construction, headed by Day Okes, Assoc. M. ASCE, St. Paul, Minn., has included a survey of engineering personnel and salaries in its annual report on current developments in the field. The survey, which includes a comparison of current federal and state highway department salaries with the 1946 ASCE recommendations, is reported here.

LACK OF HIGHWAY engineers due to low salaries and lack of inducement as to security, tenure of office, and possibility of promotion, is one of the most serious deterrents to the highway program. A recent report of the Highway Research Board Committee on Salaries showed that there were 9,800 unfilled engineering positions in the 48 state highway departments on July 1, 1947.

The principal difficulty cited is the low salary scale in highway departments. The committee recommends minimum salary levels which would require an increase in minimum salaries in about 36 states. Even though there are 30,000 potential engineers in the universities, because of low salaries and ineffective recruiting practices, it is doubtful whether any appreciable number will reach the state highway departments; and of those who do, few will remain.

If state highway departments and city and county engineering departments are to obtain engineers, adequate salaries must be offered. At the present time industry is much more attractive to engineers than state, county, and municipal engineering departments. Something must be done to encourage young graduates to enter public employment in the highway field. If added attraction to highway engineers, both young and old, is not forthcoming, a decided lag in the highway program will result because of lack of plans.

About a year ago a special committee of the American Association of State Highway Officials issued a report reviewing the general situation regarding classification of employees in highway departments and recommending a model classification and compensation plan. This committee based its findings on reports from all 48 states and on a detailed study of ten of the larger states. The ASCE has from time to time made recommendations as to adequate salaries to be paid for classifications similar to those existing in highway departments and in municipal and federal government work. The latest ASCE schedule was issued as of October 1946. Table I shows a comparison of the highway department, current federal, and 1946 ASCE recommendations as to salaries.

There is now a shortage of skilled construction workers. The unions, in cooperation with the Associated General Contractors, have put into effect a training program for apprentices. This is being done effectively in areas where the AGC has chapters, particularly in classifications where certain crafts are in shortest supply. This training will be increased as and if successful methods develop.

Construction workers' rates are generally and specifically controlled by union rates locally or sectionally. These rates are now in a state of flux because of higher living costs and current union negotiations. Therefore there is no general fixed rate for various classifications of construction workers. Any inquiry for useful information on construction workers' rates will have to be made in the locality of the construction project. The trend of rates is still upward.

TABLE I. STATE HIGHWAY DEPARTMENT, FEDERAL, AND ASCE RECOMMENDED SALARIES COMPARED

Annual Salaries (Average) in Ten State Highway Departments		Current Federal Employee Wage Rates		Current Recommendations of ASCE	
Grade	Rate	Grade	Rate	Grade	Rate
1	$1,500–1,945	P-1	$2,645– 3,400	I	$2,700– 3,400
2	1,925–2,735	P-2	3,400– 4,150	II	3,400– 4,200
3	2,044–2,870	P-3	4,150– 4,900	III	4,200– 5,100
4	2,580–3,685	P-4	4,900– 5,900	IV	5,100– 6,100
5	3,280–4,550	P-5	5,900– 7,100	V	6,100– 7,250
6	4,000–5,870	P-6	7,100– 8,180	VI	7,250– 8,600
7	5,005–6,980	P-7	8,180– 9,970	VII	8,600–10,350
8	7,945–9,030	P-8	9,970–10,000	VIII	10,350–12,600
9	.....	P-9	10,000 and up	IX	12,600 and up

The Committee on Developments in Highway Engineering and Construction recommends the ASCE salary schedule, with such adjustments as may be required for local conditions, for adoption by highway departments generally.

Society Prizes Spur Engineers to Greater Effort in Technical Writing

SYDNEY WILMOT, M. ASCE
Manager of ASCE Technical Publications

COMPETITION IS KNOWN to be the life of trade; just as definitely, it can be an incentive to technical advancement. The matter of Society prizes is a case in point.

The dignified ceremony of award at each Annual Meeting is the culmination of long effort and much mental torture. It all starts when the engineer is assigned an unusual or intricate job. He solves it, of course. And then he thinks—maybe some other engineers could profit by my analysis and study; perhaps they can improve on it; or at least they can give the idea constructive criticism, provided it can be published. He is sincere about this. Perhaps he even remembers that his acceptance of membership included his specific promise to contribute technical ideas for the benefit of his fellows.

A little more thought and he realizes that perhaps—just maybe—his paper might receive one of those coveted prizes. The further he proceeds the more he is sure that that idea of his is a world beater. From then on he is in a mental turmoil between realization that although the idea is great, the competition is even greater. Like the good engineer he is, he does not deceive himself with rosy expectations—he just tries to do his best to get the idea across. Thus, perhaps a bit vaguely, the prize paper is born.

That is a far cry from the acclaim of his fellows at the Annual Meeting presentation. Much toil and sweat intervene. But every prize winner knows the game was worth the candle.

Each prize award includes the bestowing of a visible symbol. A medal, sometimes a gold medal; perhaps also a certificate; frequently a check; and, in one case, a gift of books. Whatever the token or its value, the real worth is in the honor itself and the fact that it is endorsed and substantiated by the oldest national engineering society.

The winner, even if he looks at the matter coldly, is aware he has been well repaid for all his effort. Society records bear out the promise intimated in these

awards. A more glance at the names of prize winners in the Yearbook is almost a review of notables, a "Who's Who" of the profession. Most of these men will be found to have verified the early promise of their prize papers by later professional success. This is readily understandable —the intelligence that discovers better engineering methods is the best assurance of an advancing practitioner.

Specifications and statistics for the various Society prizes are given in the 1947 Yearbook, pp. 115–130. The coverage is such that no paper in TRANSACTIONS is eliminated as a possibility. One award, the Construction Engineering Prize, is open only to papers in CIVIL ENGINEERING. The variety of award is now being widened by addition of two new prizes—the Rickey Prize in the hydroelectric field, and the Moisseiff Award, for a structural paper. It is expected these two will be given for the first time in January 1949 for papers in the 1947 TRANSACTIONS.

Boston Engineers' Society Announces Freeman Award

APPLICATIONS FOR THE Boston Society of Civil Engineers one-year scholarship under the John R. Freeman Fund must be received not later than July 15, according to announcement by Howard M. Turner, M. ASCE, chairman of the fund. Such applications are to be sent to the Freeman Fund Committee, in care of the secretary of the Boston Society of Civil Engineers, 715 Tremont Temple, Boston 8, Mass.

The scholarship, covering study or research in connection with hydraulics or an allied science, provides $3,000 for tuition, traveling, and living expenses for a single man, $3,600 for a married man.

John R. Freeman, Hon. M. ASCE, in whose honor the scholarship was established, was president of ASCE in 1922.

Bibliography on ASCE Vocational Work Issued

PUBLICATION OF A new edition of *A Brief Bibliography on Engineering as a Career*, identified as ASCE Publication 1948-1, calls attention to the Society's efforts during many years to be helpful in the field of vocational guidance. In 1947, some 1,000 copies of this bibliography were distributed without charge in response to requests from libraries, high schools, teachers of college courses in vocational guidance, guidance units of the Veterans Administration, and interested individuals. About two-thirds of the requests have been for individual copies, the others being in quantity for distribution to the members of classes, groups, or schools that are concerned with student-guidance problems.

From time to time, new material is added to the memorandum and less effective material deleted. Although the list is intended to be merely an introduction to the field of vocational guidance, especially for high school students, it contains references to a comprehensive bibliography. In its present form it covers a page and a half, reproduced by the photo-offset process. Copies are available without charge upon request to the ASCE Executive Secretary's office.

South Carolina Adopts Amended State Registration Bill

A BILL AMENDING the registration law for South Carolina engineers and land surveyors, enacted in 1922, was signed recently by Governor J. Strom Thurmond in the presence of a number of ASCE members and other engineers who have been interested in obtaining an amended law.

Sponsored by the South Carolina Society of Engineers, the new South Carolina Registration Act is of special significance in that it follows the Model Law more closely than any other registration act that has been approved to date.

Section 17 of the Model Law, the "Grandfather Clause," was changed in the belief that it is unnecessary to continue the Grandfather Clause, as the old Act has been in effect for 26 years and it was necessary to provide for those engineers and surveyors registered under it. The amended Section reads:

"No person who heretofore has been duly registered as a professional engineer or land surveyor under the laws of South Carolina and whose registration has not been revoked, shall be required to register again under this Act, and his former registration shall be fully recognized under the provisions of this Act. All certificates heretofore issued and not revoked shall have the same force and effect as if they had been issued under the provisions of this Act, and shall be subject to the same rules, terms and conditions as are the certificates provided for in this Act."

Section 16 of the Model Law has been changed because the State Board of Engineering Examiners wished to have the power to reduce the annual renewal fee when funds are adequate for administration of the Act.

The only other change in the new Registration Act consists of omission of Section 18 of the Model Law requiring the state, counties and cities to engage registered engineers on public work. This proviso was not considered necessary because other provisions of the Act cover all engineering work done for such agencies.

BILL AMENDING SOUTH CAROLINA REGISTRATION LAW for engineers and land surveyors is signed by Governor J. Strom Thurmond in presence of South Carolina engineers who have worked for passage of amended law. Seated, left to right, are T. Keith Legaré, M. ASCE, executive secretary, National Council of State Boards of Engineering Examiners; Governor Thurmond; and R. L. Sumwalt, M. ASCE, dean of engineering, University of South Carolina. Standing, left to right: Edgar L. Morris, lawyer and registered engineer; H. E. Glenn, M. ASCE, past-president, South Carolina Society of Engineers; A. E. Johnson, M. ASCE, secretary, South Carolina Society of Engineers; William L. Daniel, Jr., executive secretary to governor and registered engineer; Bruce P. Barber, M. ASCE, vice-president, South Carolina Society of Professional Engineers; W. K. Beckham, M. ASCE, president, South Carolina Society of Engineers; and L. A. Emerson, M. ASCE, past-president, South Carolina Section of ASCE.

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NOTES FROM THE Capital

E. Lawrence Chandler, M. ASCE
Assistant Secretary ASCE

ENCOURAGING PROGRESS HAS been made toward enactment of legislation for creation of a National Science Foundation. Legislative Bill S.2385 was passed by the Senate on May 5. The Senate bill differed in some respects from the corresponding House bill. Most of the changes refer to the proposed Executive Committee. Under the terms of the Senate bill, that committee would have no statutory powers and would be established by the Foundation. Executive power would be vested in a director to be appointed by the President with the advice and consent of the Senate.

The Senate Bill is one which will meet with the general approval of the engineering profession. It seems likely that the Congressional Conference Committee will arrive at a final recommendation generally in accord with the Senate provisions.

It will be recalled that engineering was included in the National Science Foundation legislation as the result of presentations by the Engineers Joint Council's panel, which presented testimony during the 79th Congress. As presently written, the National Science Foundation Act "suggests" to the President that "in making appointments, due consideration be given to any recommendations . . . by the National Academy of Science . . . or by other scientific and educational organizations." Engineering societies are not mentioned specifically, but since engineering figures throughout the bill on a level equal with other sciences, and since the act specifically provides that the membership of the Foundation should include prominent men representing engineering, it may be assumed that the President will accept advice from Engineers Joint Council as a body representing the profession as a whole.

Looking forward to the possibility of early appointment of members of the Foundation, Engineers Joint Council has initiated steps for presenting to the President a list of eminent engineers from whom selection might be made.

Welding Council Sponsors Research Study at Schools

IN AN EFFORT to solve problems highlighted by wartime use of welding the Welding Research Council, a project of the Engineering Foundation, New York, is sponsoring investigations through a long-term research program.

This includes studies of weldability, structural steel, weld stresses, resistance welding, and pressure vessels. Materials used for bridges, buildings, ships, airplanes, locomotives, railroad cars, automobiles, machinery, and refrigerators will be study subjects. Research centers are located at Lehigh University, Rensselaer Polytechnic Institute, Battelle Memorial Institute, the University of California at Los Angeles, and Massachusetts Institute of Technology. The study aims to evaluate the ductility of various metals as influenced by the welding process.

Studies also are being made of the factors under which various metals become brittle, so that practical information will be readily available to designers, especially of welded joints for buildings, bridges, tanks, and ships.

Cooperating in the pressure vessel research being carried on are several government branches, insurance companies, materials suppliers, and manufacturers and users of such vessels. The objective is to develop information which will lead to better, safer and more economically constructed pressure vessels and boiler drums.

Engineers in New England Have Annual Joint Meeting

THE WORCESTER SOCIETY of Civil Engineers recently was host to a joint meeting with the New England Local Sections of the ASCE—Connecticut, Northeastern, and Providence—and the Boston Society of Civil Engineers, held in honor of the latter organization's centennial celebration.

Excursions to points of engineering interest in and about Worcester occupied the afternoon. In the evening there was a dinner meeting at the Hotel Sheraton, with guests from all over New England in attendance. More than 80 students in town for the New England Conference of Student Chapters were dinner guests of the joint group.

The need for greater participation of engineers in public affairs was stressed in the principal address of the evening by Rear Admiral W. T. Cluverius, president of Worcester Polytec hnic Institute.

NEWS OF LOCAL SECTIONS

Scheduled ASCE Meetings

ANNUAL CONVENTION
Seattle, Wash., July 21-23
(Board of Direction meets July 19-20)

FALL MEETING
Boston, Mass., October 13-15
(Board of Direction meets October 11-12)

ANNUAL MEETING
New York, N.Y., January 19-21
(Board of Direction meets January 17-18)

Coming Events

Colorado—Annual spring party and dance at the Coronado Club, Denver, June 11, at 6:30 p.m.

Hawaii—Meeting at a place to be announced, in Honolulu, June 30, at 6:30 p.m.

Philadelphia—Outing meeting for members and their wives, including inspection of Arthur Hoyt Scott Arboretum and Engineering buildings at Swarthmore College, Swarthmore, June 8, at 4 p.m., followed by dinner at 6:45 p.m.

Sacramento—Meetings at the Elks Club every Tuesday at noon. No meetings on holidays; special meetings as announced in the "Engineerogram."

San Francisco—Dinner meeting at the Engineers' Club, San Francisco, June 15, at 6 p.m.

Texas—Meeting of the Dallas Branch at the Adolphus Hotel, Dallas, June 7, at 12:15 p.m.

Tri-City—Annual dinner and social gathering for members and guests at the Watch Tower Inn, Black Hawk State Park, Rock Island, Ill., June 19.

Recent Activities

ALABAMA

CITY PLANNING WAS the theme of the Section's all-day spring meeting, which was held in Mobile. Speakers were Arch R. Winter, of the Mobile City Planning Commission, who discussed general aspects of the subject; A. Reese Harvey,

chief of the Alabama State Planning Survey, who spoke on traffic studies as an adjunct to city planning; and Harry Seale, city attorney of Mobile, whose subject was "The Legal Angle of City Planning." Wayne F. Palmer, president of the Engineers Club of Mobile, served as toastmaster at the dinner meeting, which was addressed by Rear Admiral William H. Smith. Admiral Smith, who has just retired as director of the Atlantic division of the Navy Bureau of Yards and Docks after 30 years in the Civil Engineer Corps, described Navy engineering on the Normandy beach head. The committee in charge of arrangements for the meeting was headed by J. P. Trotter, of Mobile.

ARIZONA

METHODS USED BY the U.S. Weather Bureau to obtain high-level data on wind velocity, temperatures and humidity for use in forecasting, were explained by Louis R. Jurwitz, Weather Bureau meteorologist, at a recent meeting. Mr. Jurwitz also described a new method of assembling data from the various weather stations throughout the country by a punch-card system, which will soon be in effect. At the present time the Weather Bureau is operating 550 first-order stations, he said. This service is exclusive of many other special-service stations that give frost, storm, flood and fire warnings and special weather forecasts for shipping and flying.

BUFFALO

SPEAKING ON THE topic, "Our Bright New World," at a recent luncheon meeting, Rob R. MacLeod, vice-president of the Buffalo Niagara Electric Co., discussed the reasons for the rise and fall of great empires and nations of the past, and drew certain parallels with present-day conditions in the United States. A report on the Society's Pittsburgh Meeting, prepared by ASCE Director Harland C. Woods, was read by Section President Harry M. Huy.

CENTRAL OHIO

SOME OF THE overwhelming problems facing China today were outlined by Shan Sun Kuo, a Chinese student at Ohio State University, at a joint meeting of the Section and the Student Chapter at the university. Mr. Kuo described the progress made in China immediately preceding the war, contrasting conditions then with the present-day situation. Reports on the Pittsburgh Meeting of the Society were given by three students.

CENTRAL ILLINOIS

DEVELOPMENT OF A master plan for the Champaign-Urbana area was the subject of discussion at a recent Section meeting, which was arranged by the Junior Branch. The principal speaker was William H. Scheick, coordinator of the Small Homes Council, who gave an account of events leading to the decision to prepare a community plan. He emphasized, particularly, the many personal elements involved in reaching agreement between Champaign, Urbana, and University of Illinois interests. A general discussion of local community planning problems, led by Mr. Scheick, concluded the program.

COLORADO

IN A TALK on the registration of engineers, which constituted the program at a recent Section meeting, Frank Prouty, Denver engineer, called attention to several weaknesses in the present Colorado law and suggested that the various engineering organizations in the state work toward obtaining the provisions of the Model Law. Following an open discussion of the subject, Donald P. Barnes, chairman of the Section's Committee on Registration, stated that the committee will draft a plan based on the Model Law and submit it to the Colorado Engineering Council with recommendations for concerted action.

FLORIDA

PROJECTED ENGINEERING IMPROVEMENTS for the state of Florida were discussed at a recent Section meeting, held in conjunction with the 32nd annual convention of the Florida Engineering Society. Speakers included Charles Overman, director of the Florida State Improvement Commission, Tallahassee, who outlined the objectives and accomplishments of the commission; Freeman H. Horton, consulting engineer of Bradenton, Fla., who described the proposed Pinellas-Manatee Bay crossing over lower Tampa Bay; and Harold A. Scott, Jacksonville civil engineer, who spoke on the new comprehensive plan for flood control in central and southern Florida. Stream gaging in the state was discussed, in a final paper, by A. O. Patterson, district engineer for the U. S. Geological Survey at Ocala.

CONNECTICUT

EXPERIMENTS BEING MADE at the University of Connecticut to determine efficacy of the heat pump in heating New England homes were described at a recent dinner meeting by Prof. C. H. Coogan, Jr., head of the mechanical engineering department at the university. The purpose of the experiments, which are being sponsored by the Connecticut Light and Power Co. and the American Brass Co., is to determine how much heat can be absorbed from the ground and the overall coefficient of heat transfer. Professor Coogan compared operating costs of the pump with the conventional types of heating units, pointing out that the initial cost of installing a heat pump is considerably higher than installation charges for other types.

CLEVELAND

NEW FACTS IN the air entrainment of concrete were revealed at a recent Section meeting by C. C. Oleson, senior research engineer for the Portland Cement Association. "Air-Crete," with a 20 percent air entrainment, lacks strength, but may be used for insulation, Mr. Oleson stated, pointing out that the ideal range of entrainment is 3 to 6 percent. More than 6 percent reduces the weight and strength of the concrete, and less than 3 percent makes it subject to disintegration in cycles of freezing and thawing. The principal speaker at another recent meeting was O. A. Ohman, manager of industrial relations for the Standard Oil Company of Ohio, who discussed personality adjustments in business.

GEORGIA

PLANS FOR EXPANSION of the Atlanta Water Works were detailed by Paul Weir, manager of the Atlanta Water Department, at a recent luncheon meeting. An elevated storage system for the city is one of the features of the proposed plan, which is extensive in scope. The increasing demands being placed on the Atlanta water supply made Mr. Weir's talk of special interest to members. The Juniors of the Section were in charge of another recent meeting, under chairmanship of William J. Greene, Jr.

HAWAII

IRRIGATION OF SUGAR cane by means of giant overhead sprinklers was advocated at a recent meeting by W. J. Hull, staff consultant for Castle & Cooke, Ltd. This method would have many advantages over the present surface methods with their limitations, Mr. Hull stated. The rest of the program was devoted to discussion of the proposed state constitution for Hawaii in its effect on engineers and architects. The discussion was led by Hebden Porteus, attorney and member of the territorial legislature. A joint committee of the Section, the Hawaii Engineering Association, and the Hawaii chapter of the American Institute of Architects was appointed to work with the State Constitutional Convention when Congress passes the Hawaii Statehood Bill.

ILLINOIS

RECENT PROGRAMS OF the Illinois Section have featured talks by Lorenz G. Straub, director of the St. Anthony Falls Hydraulic Laboratory of the University of Minnesota, who discussed experimental

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studies in hydraulics at a joint meeting with the Illinois Institute of Technology; Henry Penn, district engineer for the American Institute of Steel Construction, who spoke on "New Forms in Structural Steel"; and Dean C. C. Caveny, of the University of Illinois, who welcomed the group to an inspection tour of the university facilities at Navy Pier.

INTERMOUNTAIN

RECOGNITION OF THE engineering profession on a national scale has been achieved in recent years through the medium of Engineers Joint Council, ASCE Executive Secretary William N. Carey told members of the Section at a meeting held at the University of Utah. Colonel Carey pointed out that the advice of the profession has been sought in legal and military affairs, and that it played an active part in obtaining the professional provisions of the Taft-Hartley Bill. A program of student papers had been arranged by Jack Alder, of the University of Utah, who was master of ceremonies. The attendance of 70 included a number of Student Chapter members.

ITHACA

A TALK ENTITLED "What Makes America Tick?" comprised the program at a joint meeting of the Section and eight other technical societies in the southwestern part of the state. Participating groups were local chapters of the American Chemical Society, the AIEE, the ASME, the American Society for Metals, the American Society of Tool Engineers, the Photographic Society of America, the Southern Tier Technical Society, and the New York State Society of Professional Engineers. There was an attendance of 300.

KANSAS CITY

BASIC TRAINING COURSES for the engineer, similar to those given law and medical students, were advocated at a recent dinner meeting by Dr. Norman N. Royall, Jr., dean of the college of liberal arts of the University of Kansas City. Speaking on "Liberal Education and the Engineering Profession," Dr. Royall cited the profession as one of the few "that is designed, primarily, to ease the burdens of human living." He suggested that a more liberal education for engineers would enable them to present their work to the public in a better light.

Geophysical prospecting for oil with the gravimeter was discussed at a recent meeting of the Juniors of the Section by H. L. Kipfer, of the Kansas City consulting firm of Black & Veatch. He described the gravimeter, which records the varying gravitational pulls at different locations and enables accurate analysis of large strata of the earth's crust. After likely areas for oil prospecting are discovered by this instrument, Mr. Kipfer stated, they are then studied in detail by means of the seismograph.

LEHIGH VALLEY

MORE ACTIVE PARTICIPATION of engineers in professional and public affairs was urged by Congressional Representative Carl Hinshaw, M. ASCE, at a recent meeting of the Section in Easton, Pa. The record attendance of 150 included members of the Lafayette College and Lehigh University Student Chapters, who were dinner guests of the Section. New developments in concrete design and construction methods were discussed at another recent meeting which took place in Bethlehem, by C. C. Singleton, regional structural engineer for the Portland Cement Association. The final meeting of the session was addressed by Lester M. Goldsmith, chief engineer of the Atlantic Refining Co., who gave an account of the wartime experimental development and installation of the English Channel pipelines. These pipelines, known as "Project Pluto," supplied oil and gasoline to the Allied invasion forces immediately following D-Day.

KANSAS

THE CEDAR BLUFFS Project was discussed at a recent meeting of the Kansas Section by H. E. Robinson, district manager of the Kansas River Division of the Bureau of Reclamation. Part of the meeting was devoted to business discussion.

LOS ANGELES

RECOMMENDATIONS THAT THE Panama Canal be converted into a sea-level waterway to meet the threat of atomic bomb attack were presented at a recent dinner meeting by Brig. Gen. Hans Kramer, of the Army Corps of Engineers. General Kramer's talk was based on a recent report submitted to Congress by the Governor of the Panama Canal.

Prior to the regular meeting, the members of the Junior Forum heard A. M. Rawn, chief engineer and general manager of the Los Angeles County Sanitation Districts, speak on "The First Ten Years Out of College." Mr. Rawn's talk covered the function of postgraduate studies, the place of field work, and the effect of varied experience on the successful engineering career.

LOUISIANA

DESIGN AND CONSTRUCTION of the Industrial Canal steam-electric generation station of the New Orleans Public Service, Inc., were discussed at a recent meeting by John F. Vogt and Allen H. Jensen, mechanical engineers for the organization. Plans for future enlargement of the plant which supplies electric power to metropolitan New Orleans, and for coordinating such an addition with the existing facilities were shown by means of slides. ASCE Director C. Glenn Cappel spoke briefly on current Society activities, commenting particularly on the proposed constitutional amendments for increasing dues. In his capacity as chairman of the Section's Legislative Committee, Mr. Cappel also reported on progress being made by the Louisiana Council of Engineers on the proposed Engineers' License Bill.

METROPOLITAN

SPECIALIZED METHODS OF precast concrete construction developed by the Cemenstone Corp., of Pittsburgh, Pa., were discussed by A. C. Grafflin, vice-president and general manager of the firm, at the Section's annual meeting on May 19. The Robert Ridgway Student Chapter prizes, awarded by the Section through its Committee on Student Chapters to the outstanding senior in each of the Metropolitan Student Chapters, will be reported later. New officers of the Section are: Roger W. Armstrong, president; Col. W. J. Shea, vice-president; Alfred Hedefine, secretary; C. E. Trout, treasurer; Alfred T. Glassett, J. P. Riley, and Seth Hess, directors.

The history of the New York City water supply was outlined by Irving V. A. Huie, president of the Board of Water Supply, at a recent meeting of the Junior Branch. Members of the Branch are planning an inspection trip to the Catskills, where new reservoirs which will increase the metropolitan water supply are under construction. The principal speaker at another recent meeting of the Branch was Malcolm Douglas, who described his adventures in the South Polar regions while a member of Admiral Byrd's expedition.

MIAMI

STATE AND FEDERAL regulations controlling the construction of jetties and groins, which are causing erosion of Florida Coast beaches by interfering with the natural movement of the sand deposits, were advocated at the May 6 meeting by Morris Lipp, city engineer of Miami Beach. Mr. Lipp pointed out that the sands of the Florida beaches come originally from the Savannah and other rivers to the north, and are carried southward along the Florida coast line by wave action.

MID-MISSOURI

WORK OF THE Army Corps of Engineers to improve navigation of the Middle Mississippi has aided, incidentally, in diminishing flood conditions, according to Col. R. E. Smyser, Jr., district engineer for the St. Louis District office of the Corps of Engineers. Speaking at a joint meeting of the Section and the Missouri

School of Mines Student Chapter, Colonel Smyser gave a historical résumé of the Corps of Engineers navigation work and presented data indicating that it has had a favorable effect on flood control.

NEW MEXICO

A GENERAL ROUND-TABLE discussion of Society and Section activities, headed by ASCE Executive Secretary William N. Carey, highlighted a recent dinner meeting of the New Mexico Section. Topics discussed included the role of Engineers Joint Council and state engineering organizations in promoting the welfare of the profession; collective bargaining; Army use of engineers in the recent war; and the proposed constitutional amendments to increase Society dues.

NORTH CAROLINA

A DIVERSE TECHNICAL program had been arranged for the Section's all-day spring meeting, held at Duke University on May 1. The list of speakers included M. A. Arnold, president of the Arnold Stone Co., Greensboro, N.C., who discussed precast concrete construction practices in Germany in the past decade; Albert L. Cochran, chief of the Hydrology and Hydraulics Bureau of the Office of the Chief of Engineers, who spoke on the role of hydrology in engineering; and J. A. Sousa, president of the Duke University Chapter, who gave an illustrated talk on the Buggs Island Dam. Student Chapter activities were reviewed by S. N. Richardson, president of the North Carolina State College Chapter, and T. E. Torgerson, secretary of the Duke University Chapter; and ASCE Director William M. Piatt reported the Pittsburgh Meeting of the Society. Following a luncheon, the group inspected the new engineering building and facilities on the Duke campus and witnessed a baseball game between Duke and North Carolina State College.

NORTHWESTERN

IN A TALK entitled "The Challenge of Modern Science," presented at the May 3 meeting, Prof. Mark Graubard, of the University of Minnesota, discussed the development of atomic energy. Following an annual custom begun in 1923, the Section presented prizes in the student paper competition for schools in the Northwestern area. Recipients were: Robert L. Solheim, South Dakota School of Mines; Jesse L. Colbert, University of North Dakota; Howard W. McCauley, Jr., North Dakota Agricultural College; Andrew Aisenbrey (first prize) and David Phillips (second prize), South Dakota State College; and Thomas W. Collins (first prize) and Charles D. Christopherson and Harlan E. Welo (second prizes), University of Minnesota. The attendance of 104 included more than 60 students.

OREGON

"ATOMIC VERSUS HYDROELECTRIC ENERGY" was the topic of discussion at a recent dinner meeting of the Oregon Section. The principal speaker was Prof. Paul Starr, of Oregon State College, who supplemented his talk with motion pictures of the Bikini bomb tests.

OKLAHOMA

PAPERS PRESENTED AT the recent two-day joint spring meeting with the Mid-South Section, in Muskogee, Okla., covered a wide range of engineering subjects. The list of speakers included W. E. Barker, regional highway engineer for the Portland Cement Association at Dallas, Tex., whose subject was air-entrained concrete in highway work; Albert C. Coldwell, of the Army Corps of Engineers, Tulsa, who spoke on sedimentation effects in reservoirs; and Prof. Ray E. Means, of the Oklahoma Agricultural and Mechanical College, who discussed progress in soil mechanics. A panel of engineers from the Tulsa District Office of the Army Corps of Engineers—Col. C. H. Chorpening, D. P. Grosshans, and Francis M. Newell—presented a symposium on the Fort Gibson Dam Project on the Neosho River, which was the objective of an inspection trip. A number of students read papers in a prize competition, conducted by the Section, which was won by James G. MacDonald, of the Oklahoma A. and M. Chapter, and Jack B. Cornett, president of the University of Oklahoma Student Chapter. During the business session, ASCE Director Webster L. Benham gave a report on the Society's Spring Meeting. General chairman of the joint meeting, which was attended by about 100, was Oklahoma Section President Leo L. Laine.

PHILADELPHIA

VARIOUS ASPECTS OF the housing situation were presented at the Section's May 11 meeting by a panel of Juniors. The speakers were Charles E. Roller, Jr., design engineer for John P. Hallahan & Co., who drew a parallel between construction of houses and commercial and industrial building, in so far as cost cycles are concerned; John K. White, chief engineer of American Homes Inc., who spoke on the possibility of adapting details of prefabricated houses to the individual taste of the customer; and Bernard Meltzer, Philadelphia consultant, who discussed economic aspects of the housing problem. The meeting was arranged by the Junior Forum of the Section, with Robert W. Richards acting as chairman.

MONTANA

MONTANA'S POTENTIAL WATER power is exceeded only by that of the three Pacific Coast states, A. H. Tuttle, district engineer for the U.S. Geological Survey, told members of the Section at a recent meeting. In a talk on the water resources of the state, Mr. Tuttle pointed out that the present plans of the Bureau of Reclamation and the Army Corps of Engineers call for the development of eight times the present installed capacity of Montana plants. The importance of accurate ground-water studies over a long period of time in planning long-range river development, such as the Pick-Sloan Plan, was emphasized by Mr. Tuttle. The principal speaker at another recent meeting was William F. Price, Jr., construction engineer for the Bureau of Reclamation on the Canyon Ferry Dam, who talked on the Missouri Valley Project. ASCE Western Representative Walter E. Jessup spoke briefly on the engineer's responsibility to his community.

GROUP OF MONTANA SECTION MEMBERS and guest speakers at recent well-attended meeting of Montana Section are pictured left to right: Roland H. Willcomb, of Montana State Highway Department; Stam H. Fistedis, graduate student at Montana State College from Istanbul, Turkey; Speakers William P. Price, Jr., and ASCE Western Representative Walter E. Jessup; Section President Fred E. Thieme; former Section President Charles S. Heidel; and Eldon R. Dodge, head of civil engineering department at Montana State College.

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ROCHESTER

PRINCIPLES OF THE aerial photogrammetric method of mapping were outlined at a recent meeting of the Rochester Section by W. S. Little, civil engineer for the Eastman Kodak Co. Mr. Little emphasized the tremendous progress made in this method of surveying and commented on its great usefulness during the war. The principal speaker at another recent meeting, held jointly with the Rochester Section of the ASME and the Rochester Engineering Society, was Francis G. Tatnall, manager of testing research for the Baldwin Locomotive Works. Speaking on the subject, "Making Structures Stronger by Making Them Lighter," Mr. Tatnall described improvements in the stress-strain testing technique.

SACRAMENTO

THERE IS NO reason why engineers should take a back seat in public life, ASCE President R. E. Dougherty told members of the Sacramento Section at a recent luncheon meeting. In a talk on "The Engineer in Public Affairs," President Dougherty emphasized the fact that engineers are eminently qualified to play a part in the shaping of national policies, and stated that the profession can probably render public service most effectively through the medium of EJC. Other guests of the Section included ASCE Executive Secretary William N. Carey. Progress made to date in Sacramento's municipal improvement plans was outlined at another recent luncheon meeting by Glen Hall, city planning engineer.

SPOKANE

WAYS OF IMPROVING technical programs were sought in order to facilitate the work of the program committee of the Section at a recent business meeting. Committees were named for the balance of the year, and announcement was made of a refresher course for engineers planning to take the state engineering examination. The course will be at the Gonzaga University engineering school in Spokane.

ST. LOUIS

CURRENT SOCIETY ACTIVITIES were discussed at a recent luncheon meeting by ASCE Director Webster L. Benham, who commented particularly on Board of Direction action taken at the Spring Meeting in Pittsburgh. A special analysis of Society finances and of the proposed constitutional amendments for an increase in dues was given by Harry F. Thomson, who has just retired as ASCE Director for District 14. Highlights of the Technical Division sessions at Pittsburgh were covered by Section members John I. Parcel and Hymen Shifrin. During the meeting, announcement was made of the Section's award of Junior membership in the Society to Charles S. Johnson, Jr., Washington University, and Albert G. McGuire, of the Missouri School of Mines. An exhibit of materials representing the engineering interests of various Section members, which has been planned as a regular monthly feature, constituted an innovation at the meeting.

SEATTLE

THREE FIRST PRIZES were awarded speakers at the annual joint meeting with the University of Washington Student Chapter, which was attended by students from the University of Idaho and Washington, Oregon, and Montana State Colleges. Judges announced a three-way tie in a competition between papers presented by E. R. Tinney and R. B. Beck, University of Washington Student Chapter members, and J. J. Higgins, graduate assistant at the university. Mr. Tinney's paper dealt with flow of water in pipes; Mr. Beck, who comes from Norway, talked on education in Europe and pointed out similarities and differences in opportunities for young engineers here and abroad, and Mr. Higgins' paper was devoted to results of tests on laminated wood slabs of a type used in timber bridges. Robert Currie, president of the University of Washington Student Chapter, was chairman.

SOUTHERN IDAHO

SUGGESTIONS BY MEMBERS on how to improve and promote the Section and to better the engineering profession as a whole were made by each member at a recent meeting. Suggestions presented included social gatherings, quarterly meetings with other Sections, provision of technical material to university libraries, organization of a student loan fund for worthy students at engineering schools, efforts to raise the wage levels of engineers in state highway service and other fields, and a concerted effort to "sell" the value of engineering. New officers announced at the meeting are: C. C. Hallvik, president; R. F. Hamilton, first vice-president; L. F. Erickson, second vice-president; Charles LeMoyne, Jr., secretary, and Wayne I. Travis, treasurer.

TACOMA

COMPREHENSIVE DIGESTS BY six members of the EJC committee report, "The Engineering Profession in Transition," comprised a recent dinner meeting forum, presided over by Horace J. Whitacre. Speakers and their subjects included: Paul A. Rennord, "Statistical Bases of the 1946 Survey"; Mr. Whitacre, "The Year of Transition, 1946"; James A. Gallagher, "On Active Service at Home and Abroad, 1939–1946"; Winfred T. Robertson, "On the Home Front, 1939–1946"; Arthur Johnson, "Through Boom, Depression, War and Peace, 1929–1946"; and Roy L. Greene, "Changes in Composition with Growth of the Engineering Profession, 1910–1950."

TENNESSEE VALLEY

DURING TECHNICAL SESSIONS that featured the annual two-day spring meeting of the Section, held at Asheville, N.C., on May 7 and 8, members and their guests heard addresses by Carl G. Paulsen, chief of the water resources branch of the U.S. Geological Survey; W. Vance Baise, North Carolina state highway engineer, who discussed the state's postwar highway program; and Col. John G. Ladd, chief, Engineer Intelligence, U.S. Army, whose subject was mapping problems, foreign and domestic. ASCE Director William M. Piatt was chief speaker at the meeting's dinner and dance. Names of winners of the two Section prizes of Junior Membership in the Society, W. G. Cole and J. E. Campbell, Jr., University of Tennessee graduates, were announced by Prof. Cecil Camp at the business meeting. Leon L. Parris of Chesnee, S.C., was announced winner of the Kreusi Prize at the meeting. On Saturday morning, processes and machinery used in the manufacture of cigarette paper were inspected on a visit to the Ecusta Paper Corp. plant near Brevard.

TEXAS

PRESENT-DAY ELECTRIC power and supply requirements in Texas were outlined at the May luncheon meeting of the Fort Worth Branch by W. F. Fairlamb, regional engineer of the Federal Power Commission. Mr. Fairlamb stressed the abnormal growth of power use in Texas, and discussed the steps being taken to meet current shortages.

TOLEDO

HIGHLIGHTS OF THE Spring Meeting of the Society at Pittsburgh were summarized by ASCE Director L. M. Gram at a regular dinner meeting, which was attended by several members of the University of Toledo Student Chapter. A letter to be sent to the Board of County Commissioners and the City relative to the hiring of consulting engineers was discussed and passed upon.

TRI-CITY

A PANEL DISCUSSION on water supply, treatment, and distribution made up the program at a recent dinner meeting of the Section at Muscatine, Iowa. Participants in the discussion were Dave Conan, Sidwell Smith, Robert Veenstra, and Robert Scharnberg.

STUDENT CHAPTER Notes

IOWA STATE COLLEGE

HENRY PENN, district engineer of the American Institute of Steel Construction, Inc., gave a series of three talks recently before the Student Chapter. Ellis Pickett received the annual award given by the Iowa Section, ASCE, for the outstanding civil engineering student. Chapter members have been working on plans for their part in the annual Veishea, Iowa State's annual open-house program, preparing working models and demonstrations connected with various phases of civil engineering. The Chapter also had a float in the parade. Albert P. Boysen, design engineer with the American Bridge Co., addressed the Chapter on "The Young Engineer's Place in Industry" at the final meeting of the quarter.

A. & M. COLLEGE OF TEXAS

OPPORTUNITIES FOR YOUNG engineers in the steel industry were outlined by R. B. Tatum, of the Basen Steel Works, Houston, Tex., at a recent meeting of the Texas A. & M. Student Chapter. He reviewed problems encountered by the young engineer and pointed out that the only way to get experience is by doing the work. Kenneth M. Smith, chief of the construction division of the Galveston District of the U.S. Engineers, told the Chapter at another meeting that "today the full power of the Corps of Engineers is turned to construction of peacetime projects." The speaker traced steps from start to finish in a civil construction project of the Corps of Engineers. The Corps strives to place an individual in his best field so that he will be happy and interested in his work and therefore more efficient, M. R. Royar, head of the personnel branch of the Galveston District, told the Chapter.

RENSSELAER POLYTECHNIC INSTITUTE

ASCE Assistant Secretary E. Lawrence Chandler spoke on Student Chapter activities at the annual banquet of the Rensselaer Polytechnic Institute on May 10. More than 100 attended. New officers installed at the banquet are Andy Drozda, president; Ed Flanagan, vice-president; Dick Pfundstein, secretary, and Wayne McNally, treasurer. Steel and concrete construction work, as exemplified in the new R.P.I. field house, was studied by 30 members of the Chapter during a recent all-day field trip. D. B. Steinman, New York consultant, spoke on "The Advancement of Science and Bridge Engineering" at a spring meeting of the Chapter. An open house program, exhibiting work of the engineering department of the institute, was held recently. The summer practice surveying tour will be centered at Green Mountain Junior College, Poultney, Vt., beginning June 8

UNIVERSITY OF ARIZONA

ASCE WESTERN REPRESENTATIVE Walter E. Jessup discussed the EJC report, "The Engineering Profession in Transition," at a recent meeting sponsored by the Chapter and attended by Arizona Section members living in the Tucson area and members of the university chapters of the other engineering societies. The Chapter recently sponsored the first joint meeting of university chapters of the four Founder Societies, with an attendance of almost 150. Newly elected officers of the Chapter include Ted H. Rowcliffe, president; Robert C. Hall, vice-president and corresponding secretary; William Oliver, recording secretary; and Clark Gerry, treasurer. Named to serve with officers on the executive board were Bruce Jaeschke, William Johnson, and Robert Norton.

CITY COLLEGE OF NEW YORK

FIFTY-THREE new Student Chapter members, the largest number in the Chapter's history, were welcomed recently at the semiannual induction ceremony attended by the entire engineering faculty of the college and many alumni. Prof. Charles W. Cunningham, Faculty Adviser of the Chapter, spoke to new members on their future membership in the Society. They were sworn in by Herbert Wasserman, Chapter president. An entertainment program was presented by faculty members impersonating students and seeking such "reforms" as less homework and fewer classes.

ENGINEERING FACULTY members taking part in City College Student Chapter induction ceremonies are, left to right: William J. Armento, ASCE Contact Member for Chapter; William Allan, dean of City College School of Technology; and Charles W. Cunningham and Walter L. Willig, civil engineering professors.

STUDENT CHAPTER MEMBERS from City College of New York make inspection trip to New York City's new International Airport. Group is photographed on highway, which will extend under taxiway shown here into central area of airport.

WASHINGTON STATE COLLEGE

STUDENT CHAPTER MEMBERS had a joint meeting and banquet with University of Idaho Student Chapter members recently at Pullman, Wash. Walter E. Jessup, ASCE Western Representative, discussed the EJC report, "The Engineering Profession in Transition," using slides to illustrate his talk. The attendance of 74 included several guests from Spokane and Lewiston, Idaho, together with faculty members of the Society from both schools. Officers of the Washington State College Student Chapter include: Eric T. Batchelor, president; Kenneth Bybee, vice-president; Edworth L. Ray, secretary, and Peter Denny, treasurer.

UNIVERSITY OF NORTH DAKOTA

THE CHAPTER REPORTS great progress in the postwar years and a fourfold increase in membership over its 1942 enrolment. Present officers are: John Olgeirson, president; Albert Couvrette, vice-president; Lyle Thompson, secretary; and Harris Anderson, treasurer. Duane Schue was appointed publicity chairman and Kenneth Falstad, corresponding secretary. Committee members for the annual Engineers' Day are Jesse Colbert, chairman, James McLaughlin and Roy Verden. Recent guest speakers include ASCE Mid-Western Representative George S. Salter, who spoke on Society and Student Chapter affairs of interest to the group, and Milan A. Johnston, of the Portland Cement Association, who gave an illustrated talk on air-entrained concrete.

JOHNS HOPKINS UNIVERSITY

RECENT INSPECTION OF the new Baltimore Municipal Airport by more than 40 civil engineering students and faculty members inaugurated a series of field trips planned by the Chapter. Benjamin E. Beavin, project engineer for Whitman, Requardt, Greiner Associates, conducted a tour of the project and explained how the recently acquired 200-ton super-compactor will result in a saving of more than $2,000,000 through its use on the 700,000-sq yd area to be paved for the airport.

MEMBERS OF Johns Hopkins University Student Chapter inspect 200-ton super-compactor used in spectacular earth-moving operations at construction site of Baltimore Airport.

GEORGIA SCHOOL OF TECHNOLOGY

RALPH P. BLACK, ASCE Life Member, associate professor of civil engineering at the Georgia School of Technology, was honored recently upon his retirement as faculty adviser of the school's Student Chapter. He has been closely associated with the Chapter since 1924, when he assisted in obtaining its charter. Prof. T. H. Evans, head of the department of civil engineering, presented Professor Black with a scroll which was designed by Donald G. Lattimore, president, and J. S. Kendall, secretary, of the Student Chapter.

TEXAS A. & M. COLLEGE

ENGINEERS ARE THE "biggest bunch of recluses in the world today," George G. Smith, vice-president of the Texas Construction Material Co., Houston, told members of the Chapter at a recent meeting. Speaking on "The Significance of Salesmanship to the Civil Engineer," Mr. Smith pointed out that sales engineering is something that affects every engineer and engineering graduate. He cited courage, conquest and confidence as essentials to good salesmanship. Total membership of the Chapter now exceeds 350, with a goal of 400 set.

UNIVERSITY OF NEBRASKA

FIFTY-FIVE MEMBERS of the Chapter visited the Ash Grove Cement Plant at Louisville, Nebr., on an inspection tour recently. Paul C. Benedict, district engineer, U.S. Geological Survey, spoke on "Sedimentation Studies in the Missouri River Basin," at a recent meeting. Twenty new members have joined the Chapter and are helping with plans for the annual engineers' week program in which the Chapter will have displays. Officers of the group include: Charles Cole, president; Melvin Thompson, vice-president; A. Ivan Johnson, secretary, and Paul Nylander, treasurer.

UNIVERSITY OF NEBRASKA STUDENT CHAPTER members visit Ash Grove Cement Plant at Louisville, Nebr., on recent inspection tour.

NEWS BRIEFS

Steady Increase in Construction Activity Reported

NEW CONSTRUCTION PUT in place during March had a total value of $1,088 million, a more than seasonal increase of 17 percent over February, according to a recent U.S. Department of Commerce Industry Report. The March figure was 32 percent above that of March 1947.

Privately financed new construction, valued at $852 million, accounted for almost 80 percent of the March total. Privately financed residential construction (exclusive of farm houses, trailers and conversions) was valued at $450 million, a more than seasonal increase of 20 percent over the February figure. The value of privately financed non-residential building was $268 million, an increase of less than 1 percent over the February total. Public utilities (privately financed) spent $111 million for new construction, 13 percent more than in February. Farm construction amounted to $23 million, an increase of $9 million over the figure for February.

The total value of publicly financed construction for March was estimated at $236 million, an increase of 37 percent from the previous month. Of this total, public residential building amounted to $6 million; non-residential building, $69 million; military and naval construction, $15 million; highway building, $60 million; sewer and water facilities, $33 million; and conservation and development, $35 million.

For the first three months of this year, all new construction activity amounted to $3,082 million, 25 percent above the figure for the corresponding period in 1947. Private construction, valued at $2,469 million, constituted 80 percent of the total and was 27 percent above the dollar volume put in place during the first three months of 1947. During the first quarter of 1948, new public construction totaled $613 million, 20 percent above the figure for the corresponding period in 1947.

Measured by 1939 prices, the level of all new construction in February (the most recent month for which estimates are available) was 14 percent below January. Privately financed new construction in February, measured by 1939 prices, was 13 percent lower than in January, while the total volume of publicly financed construction was 16 percent lower.

These construction activity estimates represent the value of "work put in place" in a given period on all projects on which construction work was under way during the period, including projects begun in prior periods as well as those started currently. "Work put in place" is defined as being equivalent to the cost of materials installed plus estimated expenditures for labor and overhead.

European Building Costs Seen Higher than Those of U.S.

BUILDING COSTS IN Western European countries have increased in greater proportion than costs for similar structures in this country, and it will be years before their building programs are brought up to date. These opinions were expressed by John W. Harris, New York and Chicago builder, who returned from Europe in May following a survey of cost and material conditions in the construction industry in England and France.

Building firms in these two countries, he said, are faced with many of the basic problems contributing to rising costs in the United States, including great shortages of almost all building materials, shortages of both skilled and unskilled workers, and decreases in productivity per man-hour in spite of rises in hourly wage rates. Strict governmental allocation and control programs which permit only a limited amount of building activity because of scarcities of materials add to the slow-down, Mr. Harris said.

It will be at least two years before builders in England can begin cutting into the backlog of construction, he said. This backlog has been stock-piling for almost a decade of war and postwar uncertainty. From three to four years will be required in France before most projects can go ahead. Most construction activity now in progress is confined to low rental housing and to the rehabilitation of industrial plants upon which national economy depends.

ASCE Member Addresses Vocational Aid Symposium

EDUCATION FOR RESPONSIBLE citizenship will not come from general education as we know it today, Harry S. Rogers, M. ASCE, president of Polytechnic Institute of Brooklyn, said in an address before the recent Inter-Professions Conference on Education for Professional Responsibility at Buck Hill Falls, Pa. Declaring that engineers are skeptical of the methods and achievements of general education, President Rogers said, "We have listened too long to such trite expressions as 'the liberal arts prepare one for living, whereas specialized training prepares one for making a living.' It seems apparent that those who make such statements are confusing the cumulative contributions of liberal culture to mankind with achievements which can be reasonably expected from two years and eight months of general education.

"To achieve results in the education of students for responsible citizenship . . . will require a more specific determination of the social and philosophical consideration of general education by competent philosophers as well as a more comprehensive and valid development of the theory of mental organization and the structure of personality on the part of psychologists.

"It is conceivable that there may be strong opposition to departure from a position of neutral scientific detachment within the areas of general education, but should we fail to undertake the correlation of knowledge with the conditioning of attitudes and behavior we had better stop prating about preparation for responsible citizenship."

Other speakers on the engineering aspects of education at the three-day conference were Elliott D. Smith, provost of the Carnegie Institute of Technology; Thomas K. Sherwood, dean of engineering at Massachusetts Institute of Technology; and B. Richard Teare, head of the electrical engineering department at Carnegie Institute.

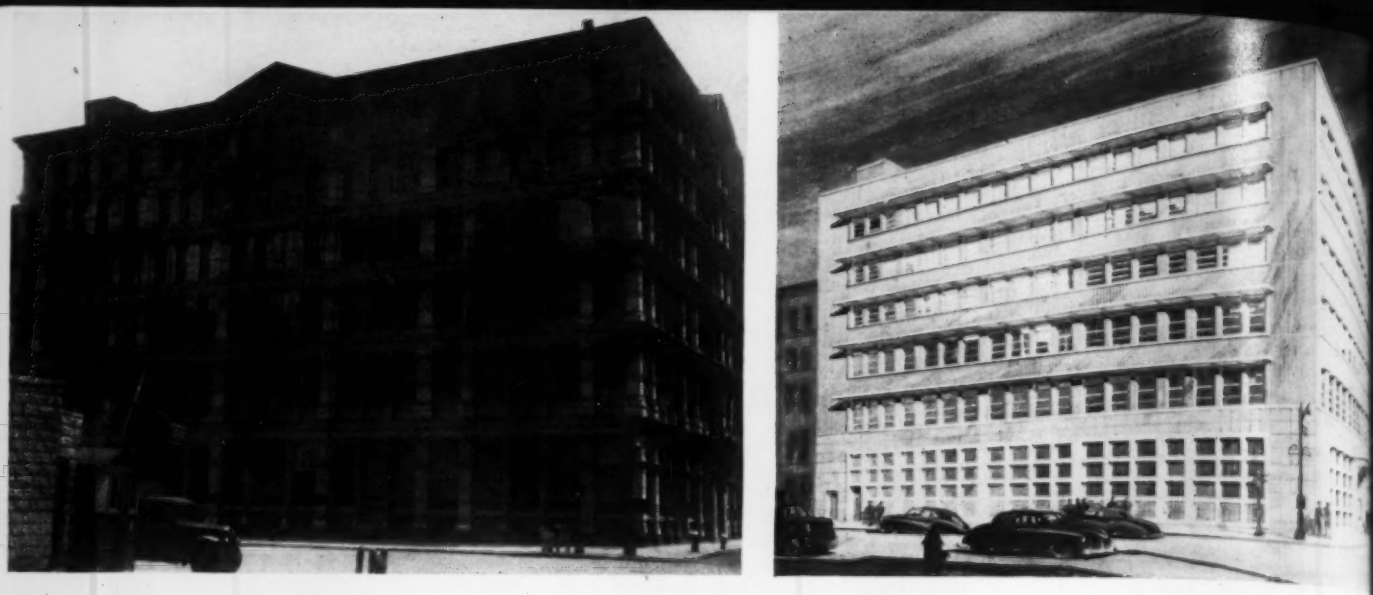
The profession was represented by 25 leaders in the field, including President Karl T. Compton, of Massachusetts Institute of Technology, and President Robert E. Doherty, of Carnegie Institute.

Airport Needs Set at 4,835 Projects for Next Three Years

AIRPORT PROJECTS COSTING an estimated one billion dollars should be undertaken throughout the country during the next three years, according to the Civil Aeronautics Administration in its current National Airport Plan. These projects include 2,745 new airports and the improvement of 2,090 existing ones. Such development of airports under Federal aid is considered barely adequate to anticipate and meet the needs of civil aeronautics at the end of the three-year period.

On the basis of a total cost of slightly more than one billion dollars, the average cost of airport development per location will be about $217,000, with local sponsors providing 75 percent of the funds for necessary land acquisition. Local sponsors, in most instances, also bear 50 percent of the cost of planning and construction phases of new airport development or the improvement of old ones, with such sponsors' share of the total expense amounting to $578,800,000.

The CAA report is summarized in the current issue of "Out at the Airport," release of the Airport Division of the American Road Builders' Association.



Face-Lifting Job Transforms Old Cast-Iron Structure

PROPOSED MODERNIZATION OF LOWENSTEIN BUILDING in downtown Manhattan involves resurfacing of original cast-iron facade (above, left) with granite facing at first-story level and pre-formed aluminum facing above. Built in 1880, structure was one of high points reached in use of cast-iron before introduction of structural steel as building material. New exterior design (above, right) requires no important revision of original cast-iron structure, despite conformance with contemporary design standards. Renovation, including complete modernization of interior, will be less than 60 percent of cost of new building of equal size. New York City consulting firm of Peter Strobel, M. ASCE (Strobel & Salzman), is serving as structural engineering consultant on project, and Petroff & Clarkson, of New York, are architects.

ARBA Chicago Road Show Anticipates Record Attendance

PLANNED AS THE greatest among 31 such shows held during the past 39 years, the 1948 American Road Builders' Association Road Show in Chicago anticipates a total of more than 100,000 visitors to its extensive display area of over 1,250,000 sq ft.

Because of the lapse of eight years since the last Road Show, this year's show has been extended to nine full days, July 16 to 24, to give the entire construction and road-building industry and profession a chance to see the new developments in machines and materials of construction and maintenance.

Three hundred manufacturing firms will exhibit the latest innovations in road and airport construction equipment, and the newest and most efficient types of road building materials will be shown and demonstrated.

Some 1,000 highway engineers and highway officials from 40 nations are expected to attend the 45th annual convention of the road builders' organization at the Stevens Hotel during the period the Road Show is in progress. Cooperating with the road builders' group to give visitors a comprehensive picture of American machinery and methods, the Public Roads Administration is working on a program to present a general coverage of subjects most likely to be of interest to road builders of other countries. Thomas H. MacDonald, Hon. M. ASCE, commissioner of PRA, is in charge of this project.

Included in topics to be offered will be an explanation of government highway organization through the federal, state and county levels; historical aspects of highway development in this country since 1900; a description of methods of finance and administration; value of modern design, research and construction methods; and the importance of equipment in today's road building.

Each of the nine days of the show will be assigned to a special group or organization as follows: July 16, distributors' day; 17, international day; 18, educators' and ARBA student chapters' day; 19, Associated General Contractors' day; 20, ARBA contractors' day; 21, county day; 22, municipal and airport day; 23, all states' day; and 24, Chicago day.

California Highway Division Issues First Annual Report

TO MARK COMPLETION of the first year of California's new long-range program for coordinated highway development on all levels—state, county and city—the California Department of Public Works has issued its first Annual Report on Highway Division activities. Covering the fiscal year July 1, 1946, to June 30, 1947, the 155-page report discusses enactment of the Collier-Burns Act, which materially increased state revenue for highway uses, and covers details of expansion and reorganization of the Division of Highways to cope with the requirements of the new highway construction program.

Present long-range plans call for expenditure of about $760,000,000 for highway construction purposes within the next ten years, as compared with the Division of Highways estimate of needed projects totaling nearly $1\frac{1}{2}$ billion dollars for the same period. Thus, despite the increase in revenue, only the most critical deficiencies in the highway system can be corrected at present.

The report was prepared under the supervision of Charles H. Purcell, M. ASCE, director of the Department of Public Works, and G. T. McCoy, M. ASCE, state highway engineer.

Tulsa Project Authorized to Increase Water Supply

BUILDING A new dam and raising the present one will comprise part of a project to provide the city of Tulsa, Okla., with an additional 45,000,000 gal of water. Construction of a 15,000,000-gal high-service reservoir on hills near the city and the laying of new reinforced concrete pipeline make up the balance of the project, work on which will be done by the firm of W. R. Holway, M. ASCE, and associates of Tulsa.

Mr. Holway was engineer on the city's earlier project, completed in 1924 and providing the 25,000,000-gal capacity of the present pipeline. He will be assisted in the new project by his two sons, associates in his firm, William N. Holway, Jun. ASCE, and D. K. Holway.

Missouri River Levee Project Will Aid Agricultural Areas

WORK ON A large levee project extending some 514 miles from the mouth of the Missouri River through the Kansas City District was begun recently, following the opening of bids for the first of two units in the construction of the Missouri River Agricultural Levee System.

Col. Paul D. Berrigan, M. ASCE, is Kansas City District Engineer in charge of the program.

The initial contract is for the Forbes Levee, 26 miles upstream from St. Joseph, Mo. The Halls Levee, 12 miles downstream from St. Joseph, is the next unit. Total length of the entire levee to be constructed is 935 miles, the levees averaging 13.3 ft in height. Approximately 122,000,000 cu yd of semicompacted earthen fill will be required for the work.

Betterment of New York Is Citizens' Meeting Subject

FOUR MAJOR ASPECTS of present-day living in a large city were analyzed by authorities at a recent one-day meeting of the Better Communities for New York City Conference. The meeting, co-sponsored by the Metropolitan Section, ASCE, was a working session for residents and representatives of civic and business organizations of the five boroughs of greater New York, with the following organizations as sponsors: New York chapters of the American Institute of Architects, and the American Society of Landscape Architects; the Regional Plan Association, Inc.; Citizens' Housing Council of New York, Inc.; Citizens Union; Municipal Art Society; and New York City League of Women Voters.

Chief subjects of discussion included: What do the city's less populated sections need?; what needs to be done in the city's central areas?; the citizen and the New York City Planning Commission; and how can we fit the big city to the citizen? Members of ASCE participating included Walter D. Binger, chairman, traffic action committee, who read a paper on "How Can We Master the Traffic and Parking Problem?" and Alfred Rheinstein, president of the New York construction company bearing his name and former chairman of the New York City Housing Authority, who acted as chairman of the afternoon session program on fitting the big city to the citizen.

Sanitation Leaders Take Part in Health Assembly

SANITARY ENGINEERS, PUBLIC health leaders, scientists and representatives of milk and food producing concerns made up the group of 20 technical authorities in the environmental sanitation section of the National Health Assembly, held May 1–4 in Washington, D.C. Arthur D. Weston, M. ASCE, director of sanitary engineering of the Massachusetts State Department of Public Health, was chairman of the section on environmental sanitation.

Meeting in response to a directive from President Truman to Oscar R. Ewing, Federal Security Administrator, requesting him to formulate feasible national health goals for the next 10 years, the assembly was made up of 14 sections whose total membership is comprised of more than 800 leaders in professional and lay organizations.

In addition to the 20 technical authorities in the environmental sanitation section, an additional 20 representatives of industry and labor, farm groups and the public were members of this section. Health factors studied included air, water, milk, food, industrial and body wastes that may pollute streams, and insects and other organisms that carry disease.

Philadelphians Approve City Planners' Program

BETTER HIGHWAYS, HOUSING, rapid transit and recreation facilities are of greatest interest to Philadelphians, according to an analysis of replies to questionnaires made by the City Planning Commission from persons attending the Better Philadelphia Exhibition in that city recently. Based on approximately 10,000 replies, the analysis indicates that 68 percent approve the planning program as presented by the exhibit; 23.5 percent are undecided; and 8.5 percent are unfavorable.

A large majority, 89.6 percent, indicate that they are willing to contribute time and effort to bring about specific improvements in their own neighborhoods, while 10.4 percent indicate their reluctance to do so. A total of 48.2 percent indicate in replies a willingness to pay a little more in taxes each year to get improvements completed quickly, with the balance being about equally divided between unwilling or undecided.

Replies from visitors to the exhibition show that 3,100 persons volunteered unsolicited suggestions on improvements in facilities and services.

Trees, Shrubs to Be Placed as Headlight Glare Shield

BIDS HAVE BEEN received for installation of center island dwarf trees and plants to block headlight glare on the eight-lane Elizabeth-Newark Route 25 of the New Jersey Highway system. Proposals call for evergreens, flowering shrubs, vines and ground cover over a $^{6}/_{10}$-mile strip in Newark, planted at an angle to avoid opening in a straight-across design on the grass division strip separating opposing traffic on the "through" or "express" lanes.

An experimental section of evergreen shield completed at the Elizabeth end of the strip last year is deemed an effective safety measure to check blinding beams.

New Color Film Shows Use of Oxygen in Steel Making

A START-TO-FINISH story of stainless steel is embodied in the 16-mm color film, "Melting and Refining of Modern Steels," just completed by the Allegheny Ludlum Steel Corp. Use of oxygen and other modern techniques of electric furnace production of stainless steel as it is melted in an ultra-modern 50-ton electric furnace is shown in the 20-minute production, available upon request at the company's Pittsburgh headquarters for free showing before technical groups.

Injection of oxygen directly into molten metal for carbon reduction is shown for what is believed to be the first time in the film, with telephoto lenses used for interior shots.

Dynamometer Tests Heavy Construction Equipment

DYNAMOMETER, WITH DRAW-BAR measurement capacity of 100,000 lb, sufficient to determine horsepower requirements of largest heavy-duty earthmoving and construction equipment in use, will effect saving of thousands of dollars and man-hours. More than twice size of any previous testing equipment, device permits greater accuracy in checking new equipment than tests by dead weight and trial and error formerly in use. Dynamometer, which is shown clocking draw-bar pull of butane-burning A Tournadozer, backed by three C Tournadozers, in recent tests at Longview, Tex., was designed and built by Firestone Tire and Rubber Co.

Building Construction Service Center Planned for Denver

HUGE MILLION-DOLLAR MODERNISTIC BUILDING INSTITUTE, under construction in downtown Denver, Colo, will serve as center for display of building materials and will facilitate program for construction of homes in entire Rocky Mountain region. Representing concrete effort to coordinate building construction, Institute will offer 60,000 sq ft of floor space to exhibitors and offices of construction industry. Service to contractor will be combined with educational program to promote better building standards and aid prospective home builder or remodeler. Financed by private capital, project is sponsored by Denver University School of Architecture, Chamber of Commerce, local chapters of National Home Builders Association and Producers' Council, Inc., Colorado Contractors Association, Colorado General Contractors, and Rocky Mountain Lumbermen's Association. Architect is W. Gordon Jamieson.

Bureau of Reclamation Lists New Western Projects

SEVERAL LARGE WESTERN construction projects, upon which work is to begin shortly, are listed in the May 3 *Advance Construction Bulletin* issued by the Bureau of Reclamation. Information presented here will give an idea of the location, nature and scope of proposed reclamation projects, although the bulletin emphasizes that the data are subject to revision.

SIPHON

Columbia Basin Project, Washington

Location: Near Soap Lake, Wash.

Work: Construction of Soap Lake siphon, a concrete and steel structure 12,900 ft long.

Schedule (1)—Concrete pipe for low-head portion, steel-lined concrete pipe for high-head portion.

Excavation	478,000 cu yd
Concrete	77,300 cu yd
Furnishing and placing reinforcing steel	26,400,000 lb
Furnishing and handling cement	116,000 bbl
Furnishing and placing plate steel liner	6,000,000 lb

Schedule (2)—Concrete pipe for low-head portion, plate steel pipe for high-head portion.

Excavation	338,000 cu yd
Concrete	53,800 cu yd
Furnishing and placing reinforcing steel	11,800,000 lb
Furnishing and handling cement	80,000 bbl
Furnishing and placing plate steel pipe	25,400,000 lb

Time allowed for Completion: 1,100 days

EARTH DAM

Missouri Basin Project, North Dakota

Location: On the Heart River at Dickinson, N.Dak.

Work: Construction of Dickinson Dam, an earthfill structure approximately 50 ft high and 2,275 ft long.

Excavation	600,000 cu yd
Earthfill	282,000 cu yd
Concrete	7,300 cu yd
Furnishing and placing reinforcing steel	672,000 lb
Furnishing and handling cement	10,450 bbl

Time Allowed for Completion: 800 days

CANAL AND HEADWORKS

Columbia Basin Project, Washington

Location: Near Stratford, Wash.

Work: Construction of lining and structures for 6.6 miles of main canal from Long Lake Dam to bifurcation structure, and headworks for main canal at Long Lake Dam.

Concrete	70,000 cu yd
Furnishing and handling cement	105,000 bbl
Placing reinforcing steel	4,331,000 lb
Furnishing reinforcing steel	2,103,000 lb

Time Allowed for Completion: 500 days

CHANNEL IMPROVEMENTS

Klamath Project, Oregon

Location: About six miles south of Klamath Falls, Ore.

Work: Construction of earthwork and structures, Lost River diversion channel improvements from Lost River to Klamath River.

Excavation	1,050,000 cu yd
Furnishing and erecting timber	240 mbm
Furnishing and erecting structural steel	17,420 lb
Installing gates and miscellaneous metalwork	63,000 lb

Time Allowed for Completion: 530 days

SUBSTATION

Davis Dam Project, Arizona-Nevada

Location: Cochise, Ariz.

Work: Construction of and furnishing equipment for Cochise substation, 10,000 kva capacity

Time Allowed for Completion: 850 days

Adequate Road System Seen as National Defense Need

FAILURE TO PROVIDE adequate roads threatens national defense and the urban and rural economic existence of the country, Arthur M. Hill, chairman of the National Security Resources Board, told delegates to the second Highway Transportation Congress in Washington in May. The congress is sponsored by the National Highway Users Conference of Washington.

This is no time for complacency in the matter of highway facilities, Mr. Hill said, and it cannot be assumed that a highway plant adequate for World War II will be suitable for any future emergency, should it develop.

Alfred P. Sloan, Jr., chairman of General Motors Corp., told the congress that the demands on highways are directly related to the state of the country in terms of economic activity and development.

The interstate highway system linking 92 of the country's principal cities can be of "the utmost value to national security" H. S. Fairbank, Deputy Federal Public Roads Commissioner, told the meeting.

"Constituting in the inter-city sections little more than 1 percent of the total rural road mileage, the designated route will serve an estimated 20 percent of all rural highway usage," Mr. Fairbank said.

Diversion of highway funds to non-highway use was assailed by Baird H. Markham, director of the American petroleum industries.

"By means of tax-shifting methods, the highway users are being burdened with an unjustifiably large share of the cost of all roads, local as well as state," he said.

Virginia Highways to Have Night Driving Light Aid

PLANS ARE IN progress under supervision of the Virginia State Highway Department to stripe 2,500 miles of main or heavily traveled highways with luminous glass-beaded white paint for night driving. More than 8,000 miles of primary highways in the state will have traffic lines repainted this spring, 5,000 miles receiving plain white paint and 2,500 miles the reflectorized paint. Some of the state's longest routes will be treated with the latter paint this year, including several U.S. highways.

The state's general assembly recently voted against any diversion of highway funds. Legislation was passed providing additional money for city street maintenance in communities of more than 3,500 population.

ASCE Man Named as Aid in Greek Reclamation Project

AGREEMENT HAS BEEN made for a cooperative reclamation program between the American Mission for Aid to Greece and the Greek government toward increasing domestic food production in Greece by bringing more land under cultivation. The program will be administered by a new directorate of the Ministry of Public Works, combining the two directorates that now handle hydraulic projects. W. E. Corfitzen, Assoc. M. ASCE, an associate engineer for the U.S. Bureau of Reclamation, will serve as commissioner of water economy in the new program. He has been lent by the Bureau to the American Mission.

Mr. Corfitzen has been working in Greece under the direction of the U.S. Army Corps of Engineers since last fall. He will assist in the selection of reclamation projects and in training of Greek personnel in modern methods. An employee of the Bureau of Reclamation since 1933, he has, in recent years, worked with engineers of 31 nations who have asked the United States for help in developing reclamation programs.

Motor Vehicle Operation in Various Soils Is Studied

IN AN EFFORT to determine whether scale models can be used successfully to predict operation of full-sized motor vehicles, the Ordnance Department of the Army recently extended a contract with the experimental Towing Tank of Stevens Institute of Technology, Hoboken, N.J. The project seeks to develop methods and techniques to study the movement of motor vehicles over various types of soil.

Tests at the Towing Tank are being made in a test bin, 15 ft long, 18 in. wide and 10 in. deep, filled with Norfolk sand and equipped with a dynamometer carriage. The first problem is to determine relationship of test data obtained from a model of one size to other sizes. Type of soils to be used is under experiment at the tank, with test soil equivalent to loam, sand and clay to be used as the project progresses.

Tests will be made eventually with different wheel designs, and various styles of tracks on which tractor-type vehicles operate will be studied. At present, static tests in the bin are made with plates of elementary shape and then a geometric series of four model wheels, 4, 8, 12 and 16 in. in diameter are used for dynamic tests and the data correlated.

Soil Patterns Are Studied in Airphoto Short Course

AIRPHOTO IDENTIFICATION OF soil patterns was the subject of a five-day short course recently at Purdue University under auspices of the School of Civil Engineering and Engineering Mechanics in cooperation with the technical extension division of the university. Designed to provide instruction in the technique of evaluating problems and in evaluating soils for engineering purposes from aerial photographs, the course was attended by 65 representatives of such units as the Army Corps of Engineers, highway departments, the Bureau of Reclamation, educational institutions, public roads, and photographic enterprises.

Engineering Societies Library Announces New Service Scale

INCREASED RATES ON some services of the Engineering Societies Library to meet increased operating costs became effective June 1. To make these services self-sustaining, the Library Board authorized the following new rates:

Literature searching, $5 an hour; translations, per 100 words, in German, French, Italian and Spanish, $1.50; Russian, Dutch, Portuguese, Danish and Swedish, $2; Japanese, Chinese, Finnish and other languages, quotation of rates on request; photostats, per print, 40 cents, with a minimum charge per order of $1; microfilm, per article from one volume, $1.50; book loans, per week for each volume, 60 cents.

Discounts will continue for members of the Founder Societies at the rate of 20 percent on searches and translations, with a reduction of five cents allowed on each photostat print when ordered for personal use and paid for by personal check.

ASCE Members Speak Before General Contractors Institute

SEVERAL ASCE MEMBERS participated in a recent three-day Institute for General Contractors at the University of California extension division at Los Angeles. Designed to offer material of interest to all contractors, particularly those recently established in the southern California area, now in the midst of one of the greatest construction periods in its history, the Institute sought to meet the current demand for greater knowledge of technical, legal, and economic aspects of construction problems.

Among ASCE members who spoke were: J. G. Standley, Jr., Jun., principal assistant engineer, Division of Highways, State of California, who talked on "Prequalifications of Contractors"; Director Frederick W. Panhorst, bridge engineer for the California Division of Highways, whose subject was "Problems in Bridge Design"; Albyn Mackintosh, Assoc. M., Los Angeles consulting engineer, who talked on "Reinforced Concrete Structures"; and Clyde N. Dirlam, Assoc. M., chief building inspector, Department of Building and Safety, Los Angeles County, whose subject was "The Uniform Building Code."

Materials Shortage Story Found to Be Old as Pyramids

INGENUITY IN OVERCOMING that bane of today's engineer, materials shortage, was exercised more than 2,000 years ago in Egypt when King Imhotep, builder of the Step Pyramid and patron of builders and artisans, found himself confronted with a shortage of piling. For the first pile-driving job of which there is a record, King Imhotep resourcefully utilized the expedient of driving a pile into the soft ground as far as possible, withdrawing it and filling the hole with sand. The sand was packed as hard as possible by tamping, thereby enabling the regal pile driver to build up greater soil bearing capacity for the foundations of his temples and courts.

These facts were brought to light in a lecture on seamless steel pipe piles, by D. A. Evans of the National Tube Co., U.S. Steel Corp. subsidiary, in a recent lecture before the department of civil engineering at Lehigh University, in which he noted that today's engineering construction methods are not really new at all; that modifications of present-day methods were in use centuries ago.

Treasure Hunt Applies Modern Methods

MODERN EXCAVATING EQUIPMENT is utilized in digging for buried pirate treasure said to be worth $34,000,000, at Cove Springs, Fla. About 30 hours of digging time over 16-day period with Lorain Model TL-20 Moto crane with dragline attachment was devoted to project. Using 1 1/2-yd clamshell bucket to depth of 20 ft, searchers completed excavation with 5/8-yd orange peel bucket. Project had no storybook ending.

Pre-Engineering Inventory Test Is Scheduled for July

DESIGNED TO FURNISH objective and dependable measurement of the student's mental resources, the third of four tests this year will be given in several centers throughout the country July 10. This Measurement and Guidance Project in Engineering Education, conducted since 1943 through cooperation of the Engineers' Council for Professional Development, the American Society for Engineering Education, and the Carnegie Foundation for the Advancement of Teaching, is known as the pre-engineering inventory. Final test of the current year will be given December 11. Similar tests also were given in March and April.

Supplementing the student's high school record, the inventory furnishes such measurement of his mental resources as will aid in the selection and guidance of engineering students. It indicates whether these resources have been acquired from study or from practical experience. All tests are objective in character. Scores on a series of tests are a measure of the nature and extent of the student's actual equipment, ability, and knowledge in comparison with students accepted by colleges of engineering.

Tests include: general verbal ability, technical verbal ability, ability to comprehend scientific materials, general mathematical ability, ability to comprehend mechanical principles, spatial visualizing ability, and understanding of modern society. Time allotted for these tests varies from 25 to 90 minutes for each classification.

Scores, based upon the performance of freshman students accepted by colleges of engineering, are provided for each test. Answers are graded by machine, and tests do not follow the curriculum of any particular high school but cover broadly conceived areas of study. No special preparation is required for examination, centers for which have been set up at 27 colleges and universities located in 11 states. The fee is $5.

Complete information regarding the examinations may be obtained from the Project Office, 437 West 59th St., New York 19, N.Y. Applications must be filed not later than three weeks prior to the date of the examination.

Aluminum Progress Shown in New Color Motion Picture

CONTINUING THE STORY of aluminum begun in its earlier motion picture, *Unfinished Rainbows*, the Aluminum Company of America recently completed work on *Curiosity Shop*, a technicolor motion picture telling of research and development in the industry. A romance, in which June Lockhart, John Litel and Richard Hogan are starred, provides a backdrop for the story of progress in the field of aluminum.

Sixteen- and 35-mm prints of the film will be available for school, church, and club showings July 1. Requests are to be directed to the motion picture department, Aluminum Company of America, 801 Gulf Building, Pittsburgh 19, Pa.; to Modern Talking Picture Service, 9 Rockefeller Plaza, New York 20, N.Y.; or Farm Film Foundation, 1731 Eye St., N.W., Washington 6, D.C.

Milwaukee, Wis., Announces Structural Engineer Openings

CIVIL SERVICE EXAMINATIONS will be held late in June to fill two engineering positions in the city of Milwaukee, Wis. There is an opening for a chief structural designer at a salary of $480 a month, and one for an assistant superintendent of bridges and public buildings paying $510 monthly. Applicants must be engineering graduates eligible for registration as professional engineers in Wisconsin, with at least five years of structural engineering or designing experience. The age limit for both openings is 45 years. Further information may be obtained from the City Service Commission, City Hall, Milwaukee.

Federal, State Road Program to Pass Billion Dollar Mark

FEDERAL, STATE, AND local highway construction expenditures are expected to reach $1,500,000,000 this year, or some 40 percent of all public construction. This announcement was made recently by the American Road Builders' Association, based upon its research engineer survey findings. Expenditures for 1947 state maintenance were $371,003,027, the survey indicates, with 1948 expeditures estimated at $377,693,133.

A total of 46,821 miles of state and federal highways to be constructed during 1948, under present plans, will cost an estimated $1,072,283,810. Construction of state and federal highways this year will include 3,414 miles of concrete roads; 25,631 miles of bituminous mixes and treated types, and 17,776 miles of other types.

Soils Engineer Examinations to Be Held by N.Y. Civil Service

CIVIL SERVICE EXAMINATIONS for several openings in soils engineer positions in the New York State Department of Public Works will be held July 24, with applications to be filed by June 23. Vacancies, all in Albany, include one as principal soils engineer at an entrance salary of $8,500; two as associate at $6,700; five as senior engineer at $5,232; two as assistant at $4,242; and four as junior at $3,450. Further information may be obtained from the examination division, State Department of Civil Service, State Office Building, Albany.

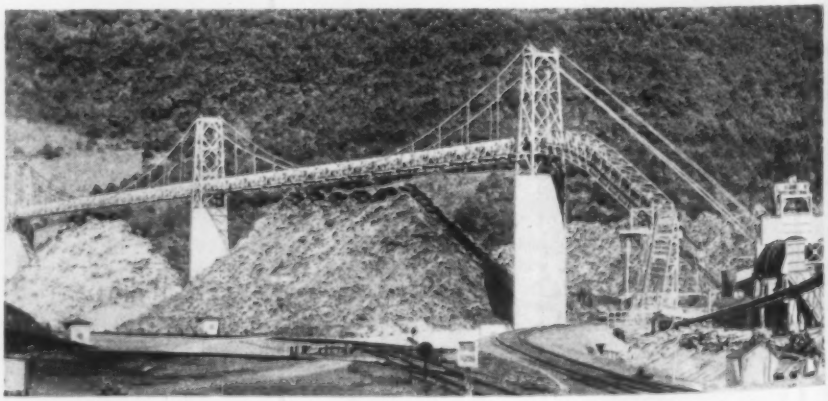
School Building Needs Set at Near 11 Billion Dollars

CONSTRUCTION NEEDS FOR schools in this country approximate 11 billion dollars if the vastly increased number of elementary, secondary and college level students are to be properly accommodated, George H. Field, Commisioner, Bureau of Community Facilities, Federal Works Agency, said recently in an article on "Can We Meet the Need for Schools?"

Attendance in the college and university group alone increased by one million in 1947, compared with 1940, bringing to 2,300,000 the number of students enrolled today. Almost 26 million children were enrolled in public elementary and secondary schools during 1947.

Through its Bureau of Community Facilities, the FWA is active in both secondary and higher educational facilities fields. It has advanced more than 23 million dollars to 2,153 school districts to plan the construction of $593,000,000 of school facilities, under the Advance Planning Program. It has assisted 1,115 institutions of higher learning and vocational schools by providing in excess of 16,000,000 sq ft of temporary structures for use as classrooms, laboratories and kindred structures.

Suspension Bridge Serves Mechanical Wood Stacker



MODERN WOOD STACKER—suspension-type bridge, carrying conveyor—makes possible mechanical storage of 40,000 cords of wood in stacks up to 80 ft high in storage yard of Covington, Va., mill of West Virginia Pulp and Paper Co. Recently completed structure designed and built by Rust Engineering Co., Pittsburgh, Pa., is supported by three towers each erected on cylindrical concrete foundations.

Greater Strength and Serviceability Obtained at Lower Cost with Arc Welding

By David R. Graham
Structural Engineer
Tulsa, Oklahoma

MANY new advancements in structural design are now made possible cost-wise through arc welded construction. Longer column-free spans, increased structural strength, greater building serviceability, are achieved *at lower building costs*. The multi-purpose building constructed for the Wright Recreation Company, Tulsa, Oklahoma, is designed for arc welded construction and serves to illustrate these structural advantages. This building, at present used as a skating rink, is so designed that it can be converted easily to a large warehouse or factory building.

With a length of 180 feet and span of 80 feet, this building has a maximum clearance height of 29 feet from floor to roof members. The rigid frame construction used produces an entirely unobstructed interior highly desirable for sports arenas or for unpredictable future conversion requirements. All roof trusses and interior columns are eliminated. High side walls, normally needed in conventional construction to obtain greater floor to roof clearance, are avoided by this all-welded rigid frame design, thus reducing structural costs.

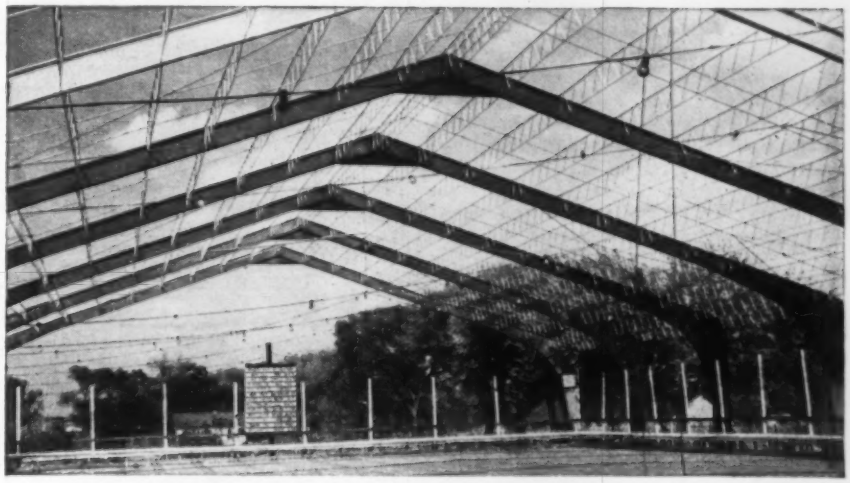


Fig. 2. Building framework for the Wright Recreation Company, Tulsa.

The arch frames (Fig. 1) are designed by the usual rigid frame formulas allowing the entire structure to support an evenly distributed snow load of 25 pounds per square foot. The design analysis also allows for wind velocities up to 70 miles per hour.

The arch frames are built from flame-cut steel plates to which inside and outside plates and ribs are fillet-welded with "Fleetweld 5" electrode. All arch frames are shop-fabricated and hauled to the site for field-weld erection. Gable members are fabricated from 16″ WF beams. Haunches and legs are welded from flame-cut steel plate.

The bar joist purlins are $\frac{5}{8}$″ steel bars, arc welded to the roof members as shown in Fig. 2. Although steel bars are a little more costly per pound than channels, they are considerably lighter, thereby reducing dead weight in the building frame.

A building of similar design, but 80 feet by 100 feet in size, is being built for a gymnasium at Kiefer, Oklahoma.

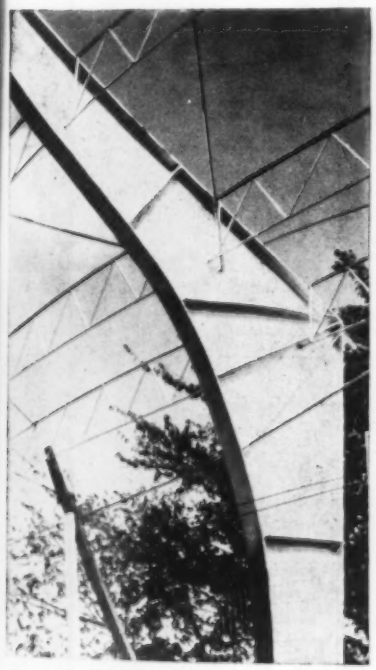


Fig. 1. Arc welded arch frame showing connections of bar steel purlins.

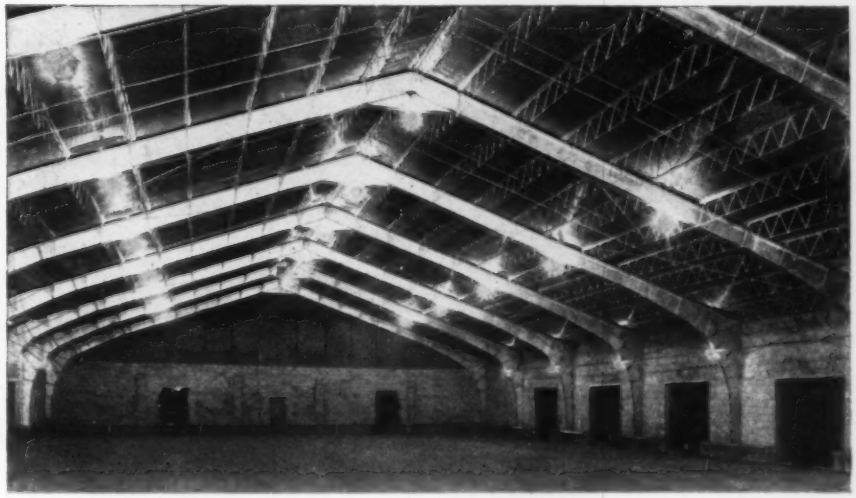


Fig. 3. Inside view of building showing completed brickwork and roofing. Fabrication and erection by the Saxon Steel Co., Tulsa, Oklahoma.

The above is published by LINCOLN ELECTRIC in the interests of progress. A full discussion on Rigid Frame Design, with formulas, is given in the Procedure Handbook ($1.50 in U. S. A., C. O. D.). Write The Lincoln Electric Company, Dept. 154, Cleveland 1, Ohio. Advertisement

Engineering Library's Head, Two Aides, Attend Convention

DR. RALPH H. PHELPS, director of the Engineering Societies Library, is attending the 39th annual convention of the Special Libraries Association in Washington, which is in progress from June 6 to 12. Dr. Phelps is accompanied by Frank Long and Miss Marguerite Culver of the library staff.

Engineering and aeronautical sections of the association are joining with the transportation section for a meeting June 10 to hear a paper on "Evaluation of Aeronautical Periodicals" and a lecture demonstration on microwaves. More than 1,000 special librarians are attending the convention.

Traffic Engineering Study Is Under Way in Los Angeles

A TRAFFIC ENGINEERING study that will serve as the basis for improvement in traffic control and in the organization and administration of a traffic department is under way in Los Angeles by the Automotive Safety Foundation. D. Grant Mickle, M. ASCE, director of the Foundation's traffic engineering division, is director and consultant for the survey. Assisting him is Joseph Havenner, Jun. ASCE, representing the Automobile Club of Southern California.

New Construction Group Is Organized in Washington, D.C.

ENGINEERS, ARCHITECTS AND specification writers recently organized the Construction Specifications Institute, Inc., with headquarters in Washington, D. C., designed for the improvement of specification writing and practices in the construction and allied industries. Goals set forth by organizers, who are in both private and public practice, include better specification writing, simpler specifications, standardization of building codes, standardized specifications for public works by the government at all levels, and study of new materials and other processes developed during World War II. It is hoped to fit these developments into the construction picture as substitutes for or improvements on costlier and scarce materials, "today retarding all government, residence and commercial construction."

Chapters of the Institute are being formed in metropolitan areas. They may be formed by groups of ten or more persons.

Engineering Congress Plans First Paris Meeting for Fall

AMERICAN ENGINEERS TRAVELING in Europe this summer may wish to include in their plans a visit to the International Mechanical Engineering Congress in Paris, September 13 to 18. Organized by the Engineering Trade Associations of the principal industrial nations in western Europe, this first such congress will emphasize presentation of the most recent information on new methods and techniques of metal working and seek to establish what lessons of a general nature, so far as the basic design of products is concerned, have been brought to light by the development of manufacturing techniques.

Inquiries may be directed to the secretary general of the congress, 11 Avenue Hoche, Paris VIII^e.

Highway Research Board Studies Roads, Makes Tests

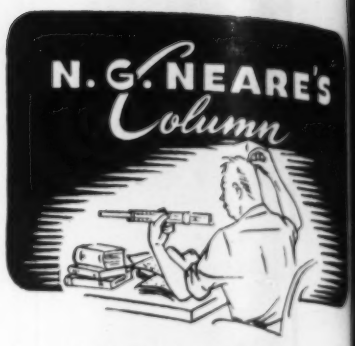
FLEXIBLE TYPE ROADS forming a great part of the mileage of improved highways in the Rocky Mountain and Plains area and the problems attendant upon their maintenance were discussed recently at a Salt Lake City meeting of the Highway Research Board of the National Research Council in cooperation with the Utah State Road Commission and the University of Utah. Delegates attended from 13 states, and a total of 20 states was represented.

An extensive series of controlled field tests is under way by the Board's Committee on Motor Vehicle Size and Weight to determine performance characteristics of various weights and sizes of trucks and combinations. This is part of a general program, the objective of which is to determine the point of maximum transportation economy in relation to pavement design and vehicle weight. First of the studies centers about operation of heavy motor vehicles on highways over the mountainous section of southwestern Pennsylvania.

Sewage Works Short Course Is Offered at Penn State

TWO SHORT COURSES for sewage and industrial waste treatment plant operators and superintendents at the Pennsylvania State College were scheduled for June 7 to 11 under auspices of the college's sanitary engineering staff. Sponsors are the Pennsylvania Sewage and Industrial Wastes Association, the Pennsylvania State Department of Health, and the college. One course is designed to meet needs of new operating personnel and operators with some experience but little training. The second is for experienced operators who have had formal training. A third will be offered next year, with successful completion of the second course this year a prerequisite for admission.

Robert E. Stiemke, Assoc. M. ASCE, professor of sanitary engineering at the college, is in charge of the short courses. Certificates will be awarded those completing the courses, which will be taught by department of health personnel, equipment and supply manufacturers, consulting engineers, and the sanitary engineering staff of the college.



R. Robinson Rowe, M. ASCE

"I HAVE BEEN told," began the Professor, "that the portable nexecutioner of Amadera County infringed upon the galloping gallows of Gallup, except that in Gallup they lengthened the rope instead of shortening the posts, in order that anti-social persons might almost have a sporting chance of miraculously escaping with a sprained ankle and a wry neck. But shortening the posts to halve the knee height and triple the horizontal reaction makes the better problem. Joe, did you find the moment of inertia of the cap?"

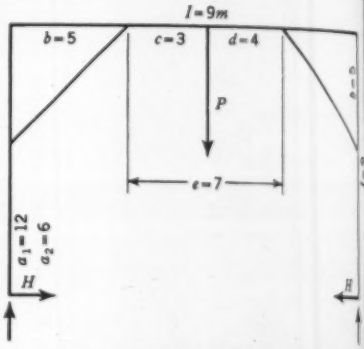


Fig. 1. The gallows is a portal.

"I have some colossal equations," answered Joe Kerr. "With your suggestion that irrelevant data be ignored, I neglected axial strains and shear deformation, but I didn't dare overlook the sidesway caused by suspending the live or dead load 0.5 ft off center.

"My equations being irreducible, I turned to the characteristic equation of the portal frame:

$$\frac{2H}{P} = \frac{b(2b + 3e) + 3cd}{2ma^2 + (a + b)(2b + 3e)} \quad (1)$$

Now if H is affected by a change in a alone,

$$\frac{H_2}{H_1} = \frac{2ma_1^2 + (a_1 + b)(2b + 3e)}{2ma_2^2 + (a_2 + b)(2b + 3e)} \quad (2)$$

and since c and d are eliminated, the portal frame equation seems to neglect sway. So I went back to my colossal equations, and that's where I came in."

"Joe doesn't know when he's well off," said Cal Klater. All he had to do was substitute $a_1 = 2a_2$ and $H_2 = 3H_1$ in Eq. 2 to get

$$2ma_2^2 = (a_2 + 2b)(2b + 3e)$$

from which $m = 62/9$ and the answer is 62. The riddle is that it makes no difference where the load is placed between the braces, and the eccentricity of the load was the irrelevant data."

. . . HIGH, WIDE and HANDSOME

GE COMPRISES 3,275' of girder
uch spans; two 184' flanking
spans; one 240' vertical lift
with two supporting towers.
bridge carries two 35' road-
with 5' dividing strip and two
ewalks. United Concrete Pipe
oration, General Contractors.

240' LIFT SPAN in the raised
ion provides 175' clearance
e the channel. In addition to
cating and erecting the struc-
steel for this bridge, Amer-
Bridge also furnished and in-
ed the operating machinery,
rical and auxiliary equipment.
bascule span shown in the
kground)

RICAN BRIDGE erecting one of
28-ton grooved sheaves on the
th Tower.

THE Commodore Schuyler F. Heim Bridge over Cerritos Channel, dedicated on January 10, 1948, eliminates a serious traffic bottleneck between Terminal Island and the mainland in the Port of Los Angeles area.

American Bridge Company fabricated and erected the superstructure, which carries 6 lanes of traffic and features a movable span of exceptional size and lift – 19,920 sq. ft. in area, and lifting 125 feet from closed to open position.

This bridge, the major link in the Terminal Island Access Freeway project, was built for the United States Navy. American Bridge also fabricated and erected 6 of the other 7 bridges in the Freeway, for the California Division of Highways.

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United States Steel Export Company, New York

UNITED STATES STEEL

"And I guess you knew you were right, Cal, when you found the answer was an integer. I took a little liberty with the classic dimensions for that purpose, but to make *H* an integer too, you'd have to give a suspended sentence to a 5,022-lb anti-socialite.

"Just one more California centennial problem. Andy, the spokesman for one party taking passage around the Horn 100 years ago, registered his name, age and destination and the names of the others in the party.

" 'I'll need the ages of the other four,' said the Purser.

" 'They add to mine,' said Andy, 'and twice their product is the year.'

"This stumped the Purser, but I'll ask, from an antiquated analogy, 'How old was Andy?' "

[*Each using a different method, the Cal Klaters were: Richard Jenney (who restated the problem in a 12-stanza ballad), Ed C. Holt, Bill Durr (Coleman W. Jenkins) and O'Kay (Otto H. S. Koch). The source of the new problem is being traced back thru the grapevine whence it came.*]

Meetings and Conferences

American Institute of Architects. "Fundamentals of Design" will be the theme of the 80th convention of the American Institute of Architects in Salt Lake City, Utah, June 22–25, inclusive. Newest advances in city planning, housing, and business structures will be discussed by authorities in architecture, business, and teaching.

American Society for Testing Materials. Technical sessions, exhibits, and an apparatus and photographic display will make up a large part of the program of the 51st annual meeting of the American Society for Testing Materials, to be held in Detroit, Mich., June 21–25. An important feature of the conference will be the 1948 Edgar Marburg lecture to be delivered by Dr. Paul C. Aebersold, chief of the isotopes division of the Atomic Energy Commission Oak Ridge, Tenn., on June 24. Headquarters will be the Book-Cadillac Hotel.

International Industrial Exposition. Many foreign nations will have industrial exhibits at the International Industrial Exposition, to be held at the Atlantic City, N.J., Pier, June 26–September 11.

Pittsburgh International Conference on Surface Reactions. Visits to Pittsburgh laboratories and round-table discussions will make up programs at the Pittsburgh International Conference on Surface Reactions, June 6–11.

U. S. Public Health Service. Research progress in the field of water, sewage, and industrial wastes will be reviewed at a meeting sponsored by the sanitary engineering division of the U. S. Public Health Service, the sanitation study section of the division of research grants and fellowships of the National Institute of Health, the water and sanitation investigations station, Cincinnati, and the Cincinnati Section of the ASCE in Cincinnati on June 14 and 15.

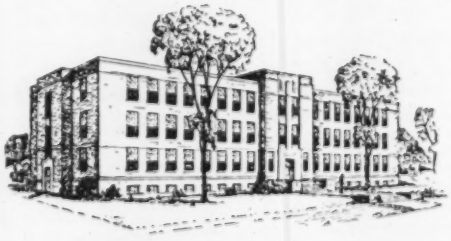
NEW IN Education

COOPERATIVE RESEARCH IS now in progress between the Georgia School of Technology's new hydraulics laboratory and the Georgia State Highway Department and the Water Resources Branch of the U.S. Geological Survey, according to a recent announcement by Carl E. Kindsvater, Jun. ASCE, associate professor of civil engineering at the school. Hydraulics research already undertaken for the State Highway Department deals with an investigation of the flow of water over highway embankments. According to Professor Kindsvater, initial tests prove that adequate protection against erosion could not be provided at a reasonable cost, and it has been decided to raise several miles of a projected highway to a level that would seldom, if ever, be exceeded by flood waters.

* * *

A SYMPOSIUM ON numerical methods of analysis in engineering was conducted at the Illinois Institute of Technology in May to mark the 25th anniversary of the first concept of moment distribution by relaxation of restraints. Dr. Hardy Cross, Hon. M. ASCE, head of the department of civil engineering at Yale University, who originated the procedure, was chief speaker at the one-day meeting. Other ASCE members taking part in the program were L. E. Grinter, research professor of civil engineering and mechanics at the institute, who was chairman of the symposium; N. M. Newmark, research professor of civil engineering, University of Illinois; and Frank Baron, professor of civil engineering, Northwestern University.

Iowa State Dedicates Building for Atomic Research



NEW METALLURGY BUILDING, which was dedicated recently, is being built by Atomic Energy Commission at Iowa State College. First of three specialized units, building will be center of important research and other work in adapting atomic energy to peacetime uses. Also nearing completion is administration building. Construction of synchrotron building (see November 1947 "Civil Engineering," page 76) will start this summer.

SEVERAL SEMINARS, SPECIAL lectures, and regular course work will make up a summer symposium on "Dynamics of Stress and Strain" at the University of Michigan, June 21 to August 14. Included in subjects to be treated are dynamics of machines and structures, elasticity, plasticity, creep, fatigue, metallurgy of engineering materials and their engineering applications. N. M. Newmark, research professor of structural engineering, University of Illinois, and D. B. Steinman, New York consulting engineer, both ASCE members, will be among authorities conducting the course.

* * *

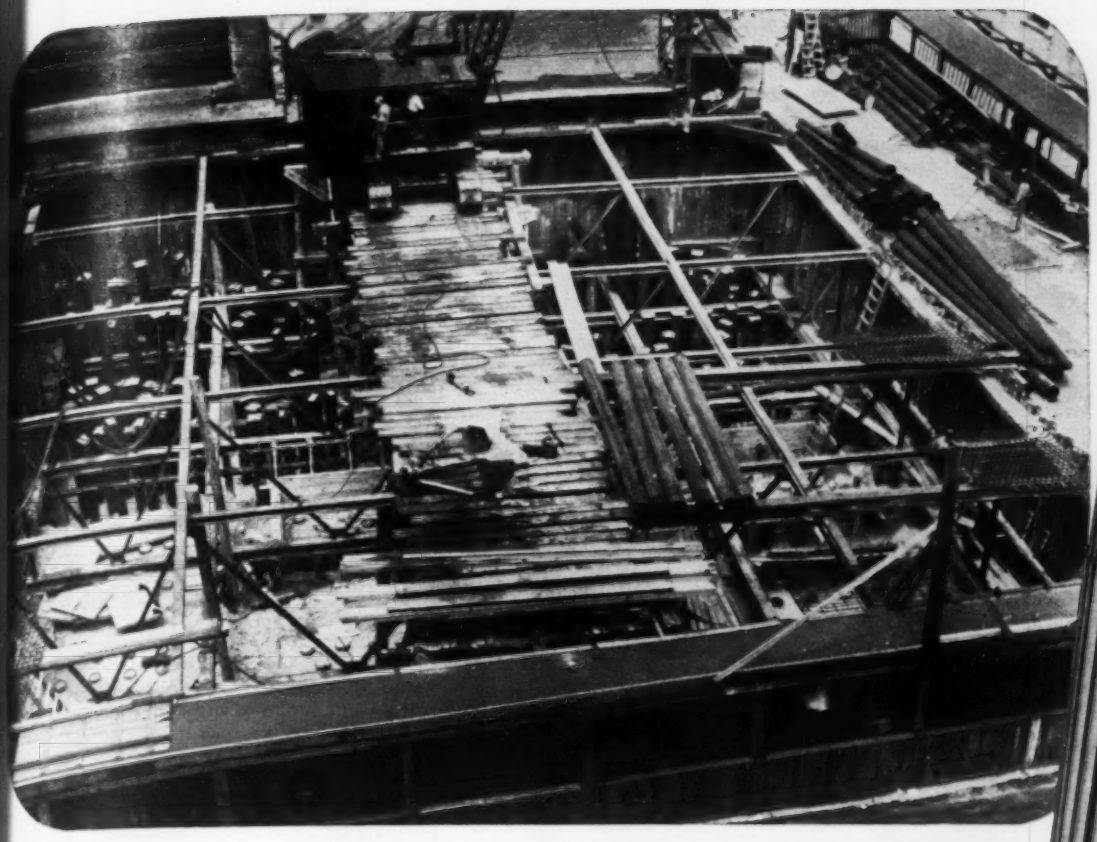
CLASSIFICATION OF TRAFFIC engineering into ten basic categories is embodied in a traffic engineering library system which catalogues nearly 10,000 works on the subject, recently completed by the Bureau of Highway Traffic at Yale University. Such categories as road users, vehicles, traffic characteristics and controls, law, education, economic and sociological aspects and planning are included in the new plan. There is also a selected bibliography of traffic engineering literature designed for use by traffic students to assist them in procuring basic reference materials as well as current periodicals and reports on traffic engineering subjects.

California University to Have Transportation Institute

FUNDS IN THE amount of $355,000 have been made available for the fiscal year 1947–1948 at the University of California for an Institute of Transportation and Traffic Engineering. Field station instruments and facilities have been allotted $225,000 of the total sum; highway materials and structures, $50,000; and administration, including maintenance and supplies, $80,000. A bill passed by the California State Legislature last year calling for an appropriation of $920,000, with provision for purchase of land and headquarters facilities, was revised to the lower figure before being signed by Gov. Earl Warren.

Engineers from federal, state, county and city agencies, automobile clubs, the Automotive Safety Foundation and the university met recently in Los Angeles and Berkeley to formulate plans for setting up the institute. Roy E. Jorgensen, deputy commissioner and chief engineer of the Connecticut State Highway Department, was chief speaker and leader of a panel discussion on highway planning criteria and objectives at conferences.

First emphasis in the program will be placed upon problems of highway planning and control in conjunction with a vast program of highway construction now under way in California. Ultimate scope of the institute will include all forms of transportation, including mass transit and rail rapid transit. The attracting and training of young engineers for service in highway planning and research projects also will be given major consideration in setting up the institute.



How an 18-story building got a good start in life

PICTURED on this page is another major construction project getting a good start—with Monotube tapered steel piles. Approximately 482 seven gauge Monotubes, 25 and 30 feet in length, were used in this foundation for an 18-story office building.

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We regret the present extended delivery schedules due to the steel shortage, but you will find Monotube Piles well worth waiting for.

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Yearbook of International Industry Now Available

TECHNOLOGICAL PROGRESS MADE in the past five years in the various fields of engineering and industry is summarized in a 400-page *International Industry Yearbook*. First in a projected annual series, the volume condenses the important technical developments described in special engineering studies, publications, and convention reports and presents them in easily understandable form for the convenience of industry. The yearbook stresses the interdependence of technological knowledge between various engineering fields, and the transference of data and information between various fields of industry. Many technical advances, which have not been publicized previously because of wartime censorship, are covered.

Both engineering and industry are widely represented in the list of contributors. Editor of the yearbook, priced at $10, is Lloyd J. Hughlett, chairman of the editorial committee of the EJC Commission on Latin America, which publishes *Adelantos de Ingenieria*.

New Publications

Public Utilities Operation. Rates, earnings, expenses, and other records of the publicly owned and operated electric systems in the United States are set forth in a new edition of *Results of Publicly Owned Electric Systems*. The 400-page volume includes records of 600 cities having publicly owned utilities; comparisons of steam, diesel, hydro, and purchased power; and information on the country's many federally owned power systems. Authors and publishers are the Burns & McDonnell Engineering Co. (P.O. Box 7088, Kansas City, Mo.), from whom the book may be purchased. The price is $10.

Highway Engineering. Proceedings of the 1947 annual meeting of the Institute of Traffic Engineers, covering a wide range of articles on traffic control and allied subjects, are now available at a cost of $2. Inquiries should be addressed to the Institute of Traffic Engineers, 211 Strathcona Hall, New Haven 11, Conn.

Private Housing. Data indicating that practically all income groups in the country are served by private home-building facilities are presented in a recent pamphlet, entitled *Who Can Afford Our New Housing?* First in a projected series to keep the public informed of construction conditions that concern it, the bulletin may be obtained from the Construction Industry Information Committee, 815 Fifteenth Street, N.W., Washington 6, D.C.

Fracture of Metals. A survey of present knowledge of the laws and fundamental mechanics of the fracture of metals is presented in a recent publication of the American Welding Society. The 58-page bulletin, entitled *The Fracture of Metals*, may be purchased from the American Welding Society, 33 West 39th Street, New York, 18, N.Y., at a cost of $1.

Traffic Control. Policies and practices employed by various law-enforcement agencies in meeting the speed problem are outlined in a 90-page publication of the Eno Foundation for Highway Traffic Control. The booklet, entitled *Traffic Speed Enforcement Policies*, may be obtained without charge from the Eno Foundation, Saugatuck, Conn.

Traffic Survey, Cincinnati. Results of a two-year survey, covering origin and destination studies of traffic in the Cincinnati metropolitan area, have been published by the Ohio Department of Highways in a 156-page report. Groups cooperating in the survey, in addition to the City of Cincinnati, were the Public Roads Administration, the Ohio Department of Highways, and the Kentucky Department of Highways.

Hydraulic Investigations. Publication of three new Waterways Experiment Station bulletins have been announced by the Army Corps of Engineers. These are Technical Memorandum No. 2-252, which covers model investigation of spillway and lock approach currents at Demopolis Lock and Dam on the Tombigbee River in Alabama; Technical Memorandum No. 2-237, on model studies of wave and surge action at the Terminal Island Naval Operating Base, San Pedro, Calif.; and Technical Memorandum No. 2-243, entitled *A Laboratory Development of Cavitation-Free Baffle Piers at Bluestone Dam, New River, West Virginia* (a paper on Bluestone Dam by Orval Auhl appears on page 28 of this issue). Copies of the bulletins may be purchased from the Waterways Experiment Station, Vicksburg, Miss., at a cost of $1 for Memoranda 2-252 and 2-237, and of $2 for Memorandum 2-243.

Wood Construction. Basic scientific and engineering information about wood and wood-base materials used in housing, particularly through factory fabrication, has been made available in a 330-page handbook, *Manual on Wood Construction for Prefabricated Houses*, by the Housing and Home Finance Agency and the Office of the Housing Expediter. Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D.C., at a cost of $1.50 each.

Bidding Procedure. Recommended bidding procedures fitting current conditions in the building and related construction fields have been summarized in *Suggested Guide to Bidding Procedure*, developed jointly by committees of the American Institute of Architects and the Associated General Contractors of America. Orders up to 25 will be supplied free of charge upon request to the A.G.C. offices, 1227 Munsey Building, Washington 4, D.C. For larger orders, a charge of 5 cents per copy will be made.

Cornell University Bulletins. A wide variety of engineering experimentation is covered in bulletins of the Cornell University Engineering Experiment Station. The current list includes: No. 13, a report on flood flows on 47 rivers in different parts of the United States, by Prof. F. G. Switzer and H. G. Miller, 15 cents; No. 15, entitled *The Effect of Clay as an Admixture in Concrete*, by Prof. H. H. Scofield and A. N. Vanderlip; No. 20, *Long Versus Short Bolt Fittings for Water Supply* in two parts—Part 1, "Experiments of Loss of Head Caused by Bends, Tees, and Crosses," by Prof. E. W. Schoder, M. ASCE, and A. N. Vanderlip, and Part 2, "Comparisons of Installation and Operating Cost," by A. T. Ricketts and T. H. Wiggin, M. ASCE—$1.25; No. 27, *The Buckling of Compressed Bars by Torsion and Flexure*, by Prof. J. N. Goodier, 50 cents; *Flexural—Torsional Buckling of Bars of Open Section*, by Prof. J. N. Goodier, 30 cents; No. 31, *The Solution of Simultaneous Linear Equations by an Approximation Method*, by Prof. L. T. Wright, 15 cents; Nos. 32 and 33, *Radiant Heating and Cooling* in two parts—Part 1, "Angle Factors for Calculations on Radiant Heating and Cooling," by Prof. C. O. Mackey and others, and Part 2, "Thermal Environment and Radiant Heating," by Prof. C. O. Mackey—40 cents each; and No. 35, *Light Gage Steel Columns on Wall-Braced Panels*, by Giles C. Green, Jun. ASCE, Prof. George Winter, M. ASCE, and Prof. T. R. Cuykendall, 65 cents.

Mosquito Control. The use of aircraft in mosquito control is covered in a 67-page illustrated pamphlet of the American Mosquito Control Association. Issued as Bulletin No. 1 of the organization, the publication is applicable to any insect problem in which aircraft can be used. It may be obtained from the American Mosquito Control Association, New Brunswick, N.J., at a cost of $1.50.

Beach Erosion. A survey of beach conditions at Waikiki Beach, Honolulu, by Donald F. Horton, Assoc. M. ASCE, is featured in the April number of the *Bulletin of the Beach Erosion Board*. Studies of beach erosion currently being made by the Army Corps of Engineers in cooperation with the various states are reported in the same issue, and there is a bibliography of new beach erosion literature that may be obtained from field offices of the Army Corps of Engineers on a 30-day loan basis.

Physics. Present-day progress in the science of physics is interpreted in *Physics Today*, a new semi-popular monthly published by the American Institute of Physics. Postwar trends in physical research abroad will be covered in a department entitled "Notes from Abroad," and a "Washington Letter" will report government developments in the field. Inquiries should be addressed to the American Institute of Physics, 57 East 55th Street, New York 22, N.Y.

Highway Safety. Functions of the national, state, and local committees of the Inter-Industry Highway Safety Committee, formed by the automotive and allied industries to encourage sound highway safety practices, are explained for the convenience of public officials and others interested in highway safety in a recent Committee brochure entitled *Policies and Operation*. Inquires should be addressed to the Inter-Industry Highway Safety Committee, 1026 Seventeenth Street, N.W., Washington 6, D.C.

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NEWS OF Engineers

Carroll L. Mann, head of the department of civil engineering at North Carolina State College, will retire June 30 after 49 years on the school's faculty. Professor Mann, a graduate of the college, is a life member of the Society and organized the ASCE Student Chapter at North Carolina State.

William C. Renshaw recently became city water engineer of Inglewood, Calif. He has been a construction engineer with the San Francisco Water Department for the past 18 years, and during the war served three years as head of Navy construction in the 12th Naval District.

Roger W. Armstrong, chief engineer of the New York City Board of Water Supply, has resigned after more than 40 years of service with the Board. He is now chairman of the board of consultants, which includes **Tobias Hochlerner** and **Russell Suter. Victor C. Brownson,** former division engineer of the Board of Water Supply, and since 1922 a member of its engineering staff, is now deputy chief engineer.

Asbury Clinton Decker, consulting engineer of Birmingham, Ala., was awarded the Diven Medal by the American Water Works Association for his leadership in developing a manual of practice for water purification engineers at the AWWA's 68th annual conference at Atlantic City, N.J., in May.

Francis J. Magnuson has resigned as city engineer of Rochester, Minn., to accept a position with William Ebertz, Inc., general contractors of St. Paul.

Louis C. Sabin, Honorary Member of the Society, has retired as vice-president of the Lake Carriers' Association which he joined in 1905. The Sabin Lock was named in his honor by Congress. He supervised the construction of this and a second lock together with a navigation canal at St. Mary's Falls, near Sault Ste. Marie, Mich., in 1906.

Norman E. Meranda recently was appointed superintendent of village utilities at Yellow Springs, Ohio. He formerly served jointly as city engineer of Washington Court House, Ohio, and as assistant county engineer of Fayette County.

Wilbur Barrows has joined the firm of Erik Floor Associates of Chicago as chief design engineer. He previously was with the International Engineers, Inc., Denver, Colo.

Robert Morrison, former city manager of Knoxville, Tenn., has accepted a similar position at Bristol, Va.

Dean Tsagaris is now in charge of structural work with Baumann & Baumann, Knoxville, Tenn., architectural firm. He was until recently with the Charles T. Main, Inc., engineering firm, working on the Clark Hill Dam near Augusta, Ga.

Fred R. Friedewald has opened an office in Belleville, Ill., following his resignation as chief assistant county superintendent of highways for St. Clair County, Illinois.

Mario G. Salvadori, assistant professor of civil engineering at Columbia University, will become an associate professor at the university on July 1.

Walker R. Young, chief engineer of the Bureau of Reclamation, Denver, Colo., will retire June 30 after 37 years of service with the Bureau. His career has included the assignment of construction engineer on Hoover Dam and power plant on the Colorado River. While Mr. Young was chief engineer, the 13-mile-long Alva B. Adams tunnel in Colorado, the world's longest irrigation tunnel, was built. Mr. Young will be succeeded by **L. N. McClellan** of Denver, who has been with the Bureau of Reclamation since 1911 and assistant chief engineer for the past three years.

W. R. Young

Chester A. Smith, partner in the Kansas City, Mo., engineering firm of Burns & McDonnell since 1920, has retired and moved to North Hollywood, Calif., to make his home. Mr. Smith joined the firm in 1909 as an associate engineer.

J. W. Pumphrey recently was appointed chief of the engineering division, Memphis District, Corps of Engineers. He has been with the Memphis District Engineers since 1931, and assistant chief since 1942.

Keyes C. Gaynor has been named city engineer of Sioux City, Iowa, a post he has held twice before. He occupied the position from 1910 to 1912 and again from 1938 to 1942. During the war he was an architect-engineer for the Army Corps of Engineers at service installations in Montana. He has maintained a consulting engineer's office at Sioux City since 1909 except for the periods when serving as city engineer.

Joseph W. Barker, president of the Research Corp., was recently made an honorary member of the Columbia Engineering School Alumni Association. **Frederick A. Goetze,** treasurer of the university, and **Dr. George B. Pegram,** dean of graduate faculties, were similarly honored. All three men are former deans of the school of engineering at Columbia. Their awards were presented at a dinner at which the Egleston Medal, given annually by the association for distinguished engineering achievement, was bestowed upon **A. Chester Beatty. Dean James K. Finch** welcomed some 300 alumni to the meeting.

Herbert S. Ayres recently joined the Dravo Corp. engineering staff in Pittsburgh. He was previously head of the bridge division of the Pittsburgh Department of Public Works.

Kenneth T. Lord is now a civilian engineer with the First Air Force headquarters at Fort Slocum, N.Y. For the past several months he has been engaged on a flood control project at Whitney Point, N.Y., in the employ of D. W. Winkelman. Prior to that he had spent 12 years in Federal civil service work with the U.S. Engineers.

Edmund R. Ricker has been appointed to the newly established position of city traffic engineer of New Haven, Conn.

Harry C. Plummer, director of engineering and research, Structural Clay Products Institute, Washington, D.C., has been made an honorary member of the Keramos, national professional ceramic engineering fraternity.

Maurice C. Lipp, formerly with the Bureau of Reclamation at Denver, Colo., has accepted a position in the Construction Division of the Bureau of Yards and Docks, Navy Department, Washington, D.C.

Thomas O. Crow is now employed on institutional design for the California State Division of Architecture, with headquarters at Sacramento.

Gordon L. Burt, former East Bay Municipal Utility District engineer, is now city manager of Hayward, Calif.

Howard E. Robbins, acting director of U.S. Bureau of Reclamation Region No. 3 for several months, recently was named director of that region. The territory includes Oklahoma, Texas, parts of Kansas and Colorado, and most of New Mexico. Mr. Robbins' headquarters will be at Amarillo, Tex.

Ralph W. Finke has resigned as bridge engineer for the Washington State Highway Department to become city engineer of Seattle. He has been with the Highway Department since 1928 and bridge engineer since 1939. He succeeds **C. L. Wartelle** who resigned as city engineer, but will continue to serve as consultant to the city engineering department. **George Stevens,** assistant bridge engineer since 1939, succeeds Mr. Finke as bridge engineer. His successor is **A. M. Buell,** for the past nine years chief design engineer in charge of all bridge design. Succeeding Mr. Buell is **W. T. Robertson,** specialist in the study of structural design, who has been with the Washington Highway Department since 1935.

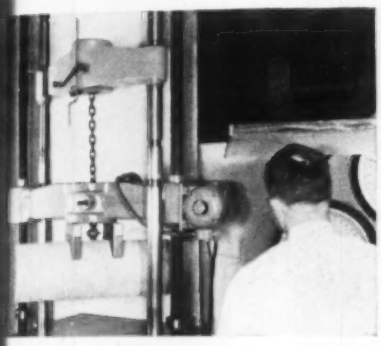
Ralph W. Finke

J. H. Tiller, Jr., recently was appointed district representative on motor graders and rollers in the south central area for the Galion Iron Works & Manufacturing Co., Galion, Ohio. His headquarters will be at Jackson, Miss. He was a colonel in the Corps of Engineers during World War II.

Charles B. Ferris, former colonel, Corps of Engineers Reserve, has been promoted to the rank of brigadier general in the Reserve Corps. He has been assigned to the command of the 410th Engineer Special Brigade, under which all reserve engineer units in the New York metropolitan area are organized and trained. General Ferris is vice-president of the Gramatan National Bank and Trust Co., Bronxville, N.Y.

Engineering Facts about
Johns-Manville TRANSITE PRESSURE PIPE
Tapping for Service Connections

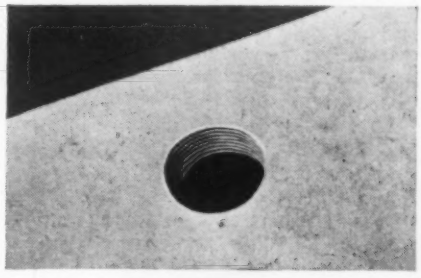
One of the many practical features of Transite* Pressure Pipe is the ease with which it may be tapped for service connections. Proof of this is evident in the hundreds of thousands of corporation stops which, over the years, have been inserted in Transite water mains. Year after year, these installations continue to serve their communities with efficiency and economy.



Laboratory tests demonstrate the strength of service connections made in Transite Pressure Pipe. In a recent series of such tests made on 8" Class 150 pipe, it required an average force of 4360 pounds to pull a ¾" corporation stop from the pipe.

Transite Pipe can be tapped wet or dry; standard tapping machines are used. The special asbestos-cement composition which gives Transite its toughness and durability also provides excellent threading properties. The threads are sharp, clean and strong. Service connections are tight and lasting.

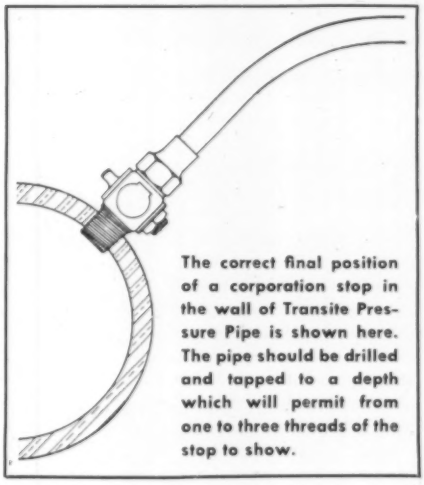
To facilitate tapping and insertion of the corporation stop, the use of a lubricant such as graphite and oil on the tap and the threads of the stop is recommended.



As this photograph shows, Transite Pipe takes clean, sharp threads. Strong and firm, these provide perfect seating for the threads of the corporation stop, assuring a watertight service connection.

Taps may be made with either Corporation Stop threads or Iron Pipe threads. While the standard combined drills and taps may be used, special alloy ones have been developed and are available from leading manufacturers. Field experience shows that these special drills and taps remain sharp after prolonged use and are more economical than standard tools.

As is true with any tapped connection, maximum strength is obtained by engaging the greatest possible number of threads of the corporation stop in the pipe wall. With Transite Pipe, this means that after the pipe wall has been properly drilled and tapped and the corporation stop fully inserted, from one to three threads of the stop will show.



The correct final position of a corporation stop in the wall of Transite Pressure Pipe is shown here. The pipe should be drilled and tapped to a depth which will permit from one to three threads of the stop to show.

Transite Pressure Pipe is readily tapped with standard tapping equipment. Here the combination drill and tap is about to be inserted in the tapping machine.

Additional engineering data relating to service connections will appear in a future advertisement in this series. For further information, address Johns-Manville, Box 290, New York 16, N. Y.

*Reg. U. S. Pat. Off.

JOHNS-MANVILLE JM PRODUCTS

Charles H. Mottier, vice-president and chief engineer of the Illinois Central Railroad, recently was elected 50th anniversary president of the American Railway Engineering Association, national authority on railway construction and maintenance. Mr. Mottier, long active in Illinois Section ASCE affairs, is at present serving it as senior vice-president. He is a graduate of the college of engineering at the University of Illinois and has been in the employ of the Illinois Central Railroad for the past 37 years.

C. H. Mottier

Howard E. Moses, for several years chief engineer of the Philadelphia Bureau of Sanitary Engineering, has been made consulting engineer; **John R. Hoffert,** former assistant chief engineer, has succeeded Mr. Moses, and **Lawson D. Matter,** district engineer with offices in Harrisburg, succeeds Mr. Hoffert and also becomes head of the waterworks division of the Bureau.

Leon A. Hostetter of Sacramento is now associated with the Morrison-Knudsen Co., with headquarters in San Francisco. He recently resigned from the Bureau of Reclamation.

Zint E. Wyant, Jr., has resigned from the bridge department of the Kansas Highway Commission to become associated with the Capital Iron Works Co. of Topeka, Kans., his home city.

Carroll A. Farwell and **Harry P. Burden** were elected first vice-president and treasurer, respectively, of the Engineering Societies of New England at its 26th annual anniversary banquet recently at Northeastern University, Boston.

Salem S. Shapiro has been named planning engineer for the City of Norwalk, Conn. He was formerly engaged in a large planning project for the City of Bloomsburg, Pa.

C. M. Wellons is retiring as technical adviser in the Pittsburgh District Army Engineer's office, after 30 years of service. Colonel Wellons was general chairman of the recent Spring Meeting of the Society in Pittsburgh.

Donald N. Becker is now chief structural engineer with A. J. Boynton & Co., Chicago technical consultants on industrial building construction and equipment. Mr. Becker, who received the Thomas Fitch Rowland prize two years ago, recently resigned after 36 years of service in the employ of the City of Chicago, the past 24 as engineer of bridge design. During this latter period he was in charge of the design of numerous movable and fixed bridges, including the North Wabash Avenue bridge which won the 1930 award of the American Institute of Steel Construction for the most beautiful bridge completed in that year and costing in excess of one million dollars.

E. D. Smith, assistant bridge engineer since 1935 for the Kentucky State Highway Department, has been promoted to the position of bridge engineer.

A. M. Zabriskie recently retired as chief engineer of the Central Railroad Co. of New Jersey after 44 years with the railroad. He will continue with the company in an engineering consulting capacity.

James B. Hays has left New York for Afghanistan to become assistant project manager in charge of engineering for the Morrison-Knudsen Afghanistan Co., a subsidiary of the International Engineering Co. of San Francisco, with which he became associated a year ago. During the past year Mr. Hays has been in Egypt, Pakistan and Afghanistan for the company.

Francis S. Friel was recently awarded a gold medal for meritorious service by the Metropolitan-Philadelphia chapter, American Public Works Association, of which he is a member, for his "splendid record as a consulting engineer on the construction of important public works, including large operations during the war," and for his service as secretary of the board of consulting engineers which advised the commission appointed to report on Philadelphia's water supply.

William Q. Reeves, with the Bureau of Reclamation since 1934, is now construction engineer on the Tucumcari Irrigation Project, having been promoted from acting construction engineer. In his new position he will supervise construction of canals and lateral ditches to serve 22,000 acres of the 45,000-acre project.

Leo M. Odom, chief engineer of the Louisiana Department of Public Works for the past seven years, resigned recently to enter private practice as a consulting engineer in Baton Rouge. He will specialize in river and harbor and flood control investigations, reports, and construction. As chief engineer, he was in charge of engineering work for the 17 active levee boards in the state and of drainage work involved in large comprehensive state-wide programs. Prior to this period he was with the Army Corps of Engineers for 12 years, engaged in river and harbor and flood control projects in Louisiana and Jamaica, B.W.I. Mr. Odom is a past-president of the Louisiana Section, ASCE.

FORMER STUDENTS of L. E. Conrad, left, ASCE Life Member who recently retired as professor of civil engineering, Kansas State College, honor him with scroll marking 40 years as teacher. L. W. Servis, right, made presentation.

Comdr. Herbert E. Smith, staff public works officer of the Navy Civil Engineer Corps stationed at the Naval Air Station, Jacksonville, Fla., has been transferred to the station at Glenview, Ill.

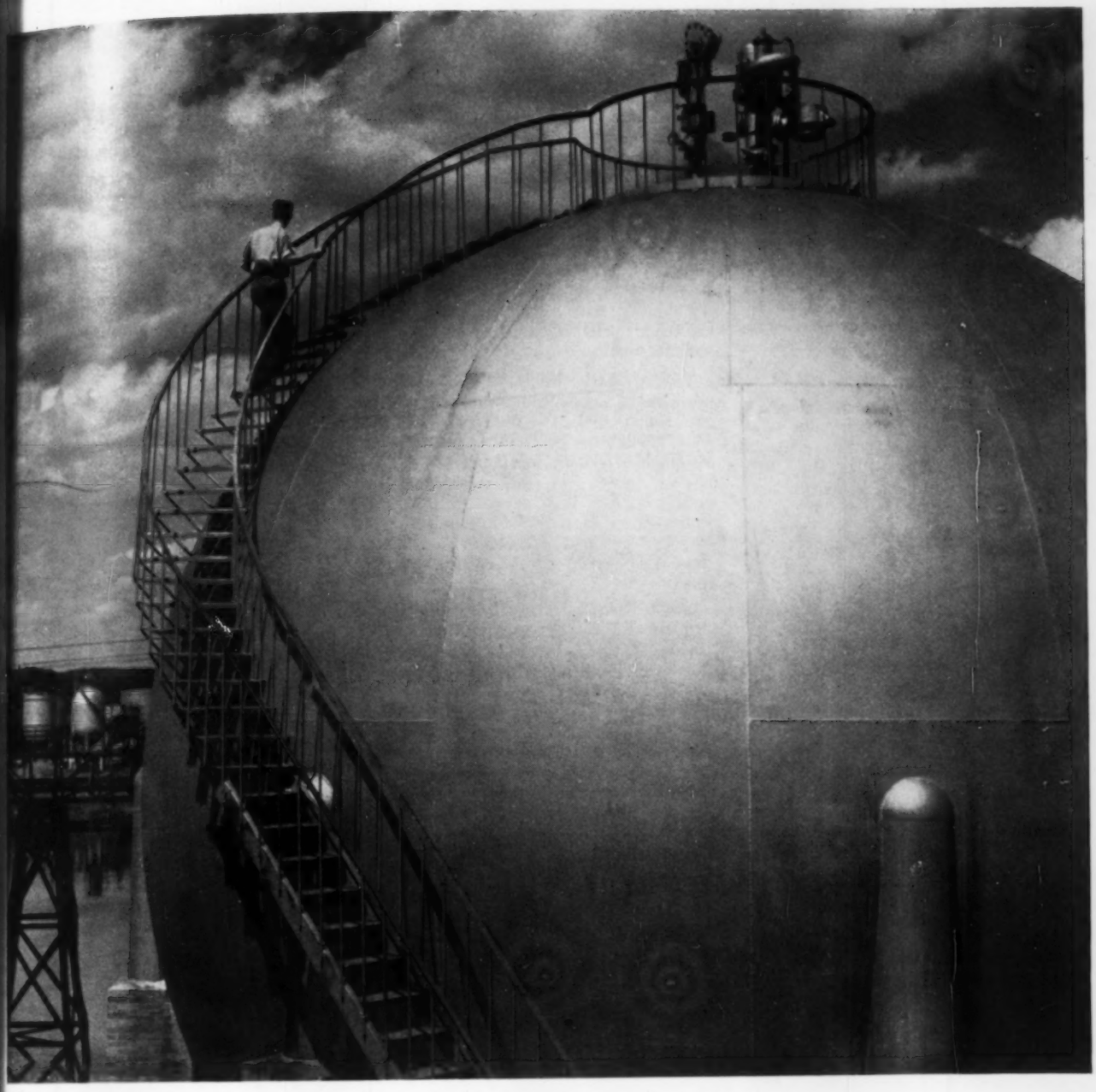
Deceased

Cecil Kirk Calvert (Affiliate '36) superintendent of purification for the Indianapolis Water Co., since 1936, died in an Indianapolis hospital on April 19, at the age of 6[illegible]. A nationally known authority on water purification and sanitation, Mr. Calvert began his career as a chemist for the U.S. Geological Survey in 1907, taking a similar position the following year with the Indianapolis Water Co. where he remained until 1921. In the latter year he became superintendent of sewage disposal and garbage reduction for the Indianapolis Sanitary District, a position he held until 1936 when he returned to the Indianapolis Water Co. to assume the position he held at the time of his death.

Allan Wadsworth Carpenter (M. '9[illegible]), former engineer of bridges for the New York Central Railroad system, died in Yonkers, N.Y., hospital on April 9, at the age of 75. He was with the Osborn Engineering Co., Cleveland, Ohio, from 18[illegible] until 1900 when he joined the New York Central. He served the railroad variously as assistant engineer of bridges, division supervisor of bridges and buildings, division engineer, engineer of structures, assistant valuation engineer and engineer of bridges until his retirement in 1943. Mr. Carpenter was at one time a member of the Interstate Commerce Commission's Railroad Carriers Valuation Commission on Bridge Cost Data. His home was in Johnstown, N.Y.

Walter Frick (Assoc. M. '96) died on December 4, 1947, according to word just received at Society Headquarters. His age was 84. He had been county engineer of Union County, Pa., for many years and made his home in Lewisburg. Mr. Frick began his career in 1884 as a construction engineer on the water works at Lewisburg. Later he was assistant engineer on preliminary surveys for the New York, Bloomsburg & Western Railroad and division engineer of the Delaware & Hudson Canal Co. Railroad, where he was in charge of laying tracks and rebuilding most of the bridges on the division. He served as city engineer of Carbondale, Pa., for a number of years.

Everson Clifton Hulbert (M. '18) died at his home in New Castle, Pa., on March 3[illegible]. His age was 84. Starting in 1910, Mr. Hulbert was for about 25 years an engineer for the Crescent Portland Cement Co., working on layout plans and plant construction, and the promotion of use of cement for paving streets and highways. Earlier in his career he was with the Wilkins & Davison engineering firm, superintending construction of blast furnace plants of the Jones &



Keeping Volatiles Under Control . . . an everyday job for the HORTONSPHERE

Hortonspheres are logical vessels for the storage of highly volatile liquids, because they are designed to withstand the pressure required to hold and control these volatiles. They also provide these additional advantages: The spherical shape utilizes material to the best advantage. There are no moving parts which might require constant supervision. The entire structure is supported above the ground, providing easy access for inspection and painting. The vapor space in a Hortonsphere remains saturated at all times, making ignition virtually impossible. Since oxygen is rarely present in the container, the inside of the shell is relatively free from deterioration due to corrosion.

When providing storage facilities for volatile liquids or gases, get quotations on Hortonspheres from our nearest office.

CHICAGO BRIDGE & IRON COMPANY

Chicago 4 . . . . . 2199 McCormick Bldg.
New York 6 . . . . . 3395-165 Broadway Bldg.
Cleveland 15 . . . . . 2263 Guildhall Bldg.
Detroit 26 . . . . . 1541 Lafayette Bldg.
Philadelphia 3 . . . . 1652-1700 Walnut Street Bldg.
Tulsa 3 . . . . . 1647 Hunt Bldg.
Birmingham 1 . . . . . 1596 North Fiftieth Street
Atlanta 3 . . . . . 2167 Healey Bldg.
Havana . . . . . 402 Abreu Bldg.
Houston 2 . . . . . 2128 National Standard Bldg.
Los Angeles 14 . . . . . 1456 Wm Fox Bldg.
San Francisco 11 . . 1284-22 Battery Street Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY, and GREENVILLE, PENNA. In Canada—HORTON STEEL WORKS, LIMITED, FORT ERIE, ONT.

Laughlin Steel Corp. at Pittsburgh and at McKeesport and the coke oven plant at Uniontown, Pa. From 1894 until 1910 Mr. Hulbert was municipal engineer for Sharpsburg, Pa.

Colin Macrae Ingersoll (M. '95) formerly chief engineer of the New Haven Railroad and chief engineer of the New York City Department of Bridges during the period when the Queensboro and Manhattan bridges were being built over the East River, died at his home, Evergreen Farm, Salisbury, Conn., on April 7. His age was 89. Mr. Ingersoll conducted his own consulting firm in New York from 1908 until 1937 when he retired. He supervised the laying of double track for the New Haven Railroad between New York and Boston during his career with the road from 1881 until 1906. He had served as a member of the Alaska Railroad Commission in 1912 and 1913, making a study of transportation problems in that territory.

Samuel Lilienthal (Assoc. M. '28) consulting engineer of Chicago, died at his home there recently. He was 50 years of age. From the beginning of his career in 1919 until 1923 he was structural designer and later chief engineer of building construction for Fridstein & Co., engineers of Chicago, having supervision of construction of multistory hotels, apartments and theaters in that city. In 1923 he entered the partnership of Oman & Lilienthal, architects and engineers in hotel, apartment, department store, church and other construction work. He continued in the organization until his death.

Henry Zenas Osborne (M. '12) of Los Angeles, Calif., died there on April 27. His age was 72. Mr. Osborne was associated with the development of Los Angeles in various engineering capacities for 50 years, serving at one time as chief deputy city engineer and later as chief engineer of the Los Angeles Board of Public Utilities. He had been executive chairman and chief engineer of the Los Angeles Traffic Commission and with the Los Angeles Department of Water and Power. He maintained a consulting office in Los Angeles for several years.

William Llewellyn Rau, Jr. (Jun.' 40) who served several years as a first lieutenant in the Air Corps, was lost in action during the war, according to word which has just reached the Society. In 1940, Lieutentant Rau was graduated from the Case School of Applied Science (now Case Institute of Technology) with a B.S. degree in civil engineering. His home was in Cleveland Heights, Ohio.

Willard Charles Robinson (Jun. '41) vice-president of Lee I. Robinson Hosiery Mills, Inc., Philadelphia, Pa., died on December 7, 1947, though the Society has just heard of his death. His home was in Elkins Park, Pa. His age was 27. A graduate of Yale University with a B.E. degree in 1941, Mr. Robinson was employed as a junior engineer with the Turner Construction Co. of New York before going into the Air Corps during the war.

Orville Frank Shattuck (M. '08) president and manager of the Dry Kiln Door Carrier Co., Indianapolis, Ind., died on Febuary 22. He was 79 years of age. He had been with the Indianapolis firm, most of the time as its head, for more than 20 years, and prior to that was engaged in private practice there for some years. He had been a member of a firm of civil and mining engineers in the Cripple Creek region of Colorado and early in the century he had an important part in development of the mines of the Gold Hill Consolidated Mining, Milling & Power Co. He had active charge of municipal improvements carried on by the Colorado Co. at Denver and at Lincoln, Nebr., and at one time was city engineer of Greeley, Colo.

Willis Robinson Tenney (M. '09) formerly chief engineer of the Brooklyn Bureau of Highways, died in the United States Veterans Hospital, Manhattan Beach, N.Y., May 2, at the age of 82. Early in his career Mr. Tenney worked on municipal projects in Maine, North Carolina and Tennessee. In 1900 and 1901 he was engaged on sewer and highway construction in Cuba and Nebraska, and later was in charge of the Division of Survey and Design in the Brooklyn Bureau of Highways until his appointment as chief engineer in 1928. He retired in 1934 after 42 years with the City and Borough of Brooklyn. He was a veteran of the Spanish American War and of World War I.

Joseph Christian Wagner (M. '06) a former assistant director of the Philadelphia Department of Public Works, died on April 2. His age was 81. In 1891, after early experience in railroad engineering, he became affiliated with the Philadelphia Department of Public Works as a draftsman. Later Mr. Wagner served as surveyor, assistant engineer in charge of sewer designs and plans and as regulator in charge of surveys and supervision of municipal engineering works. Following his service with the City of Philadelphia, Mr. Wagner was for many years in private practice as a civil engineer there.

Elwin Streeter Warner (M. '21) died at North Adams, Mass., on April 4, at the age of 65. Early in his career Mr. Warner had an engineering practice in that city, and in 1909 joined the staff of the city engineer to which he had returned last December after a 36-year interval. He served in World War I, and with the Army of Occupation. He was with the Public Roads Administration for some years, retiring from that service last summer after 11 years at the Washington headquarters. He was for 11 years a maintenance engineer for the Pennsylvania Highway Department. Mr. Warner was working on storm sewer and street reconstruction projects in North Adams at the time of his death.

Navy Dedicates New Research Laboratory at Inyokern, Calif.

(*Continued from page 45*)

In addition, the Research Department pursues fundamental research studies, not only in the interests of scientific objectives, but also to attract and retain outstanding scientists, to stimulate the entire organization through close association with research activities and by publication of important results, and to enhance the prestige of the station and the Navy in the scientific world.

The department is divided into five technical divisions—physics, chemistry, mathematics, applied science, and ballistics—manned by a staff of 130 scientists, a large percentage of whom have the doctor of philosophy degree.

Materials Test Laboratory

Radiography, or the science of X-ray photography, provides a permanent visible film record, obtainable in no other way, on the internal condition of a product without damaging it in any manner.

A complete radiographic installation will be operated by the Materials Test Laboratory; for research and production work there will be a 1,000,000-v X-ray installation capable of radiographing 7 in. of steel in about 30 minutes. A 250,000-v portable unit will penetrate a maximum of 4 in. of steel or 10 in. of aluminum in 1 hour, but $2^1/_2$-in.-thick steel in one-half minute. A 140,000-v unit will be used for very thin material and light alloys such as magnesium and aluminum.

These three machines will be housed in a concrete room approximately 40×50 ft and three stories high. The walls are of 2-ft-thick concrete and are lined with $^1/_4$ in. of lead to safeguard operating personnel. The concrete door to this room, approximately 13 ft square and 2 ft thick, weighing 84,000 lb, can be operated by pneumatic-hydraulic controls which provide a complete opening or closing in less than one minute.

Large hydraulic testing machines enable tension and compression loading on specimens at temperatures from minus 80 to 1,600 deg F. While very fine wire can be tested under loads as low as 5/100 of a lb, and large specimens under loads up to 40,000 lb, strains as small as 2/1,000,000 of an inch can be detected. A large variety of fatigue testing machines will enable tests to be performed under repeated compression and tension loads up to 20,000 lb at rates up to 1,800 times a minute.

An assortment of hardness testing instruments is on hand which can test materials ranging from soft rubber to diamonds. Facilities are also in operation to perform vibration, metallurgical and chemical tests on materials, and to make accelerated

(*Continued on page 92*)

OPERATING EFFICIENCY

"WESTINGHOUSE-EQUIPPED THROUGHOUT" MEANS SIMPLIFIED ORDERING, QUICKER INSTALLATION, MORE EFFICIENT OPERATION

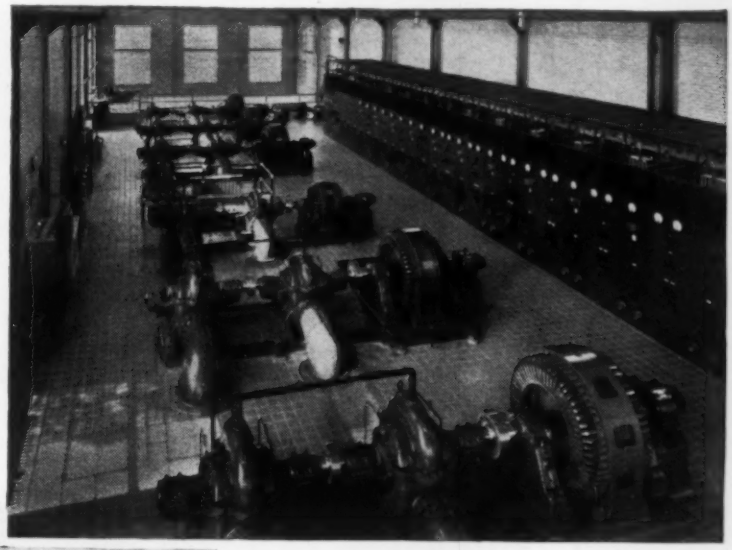
...ting power to work *efficiently* can be a major ...blem—or a simple one. When items must be ...cted, ordered and received from many sources, it ...ans many chances for costly errors and delays . . . ...ided responsibility—or none at all—for perform... ...e of installed equipment.

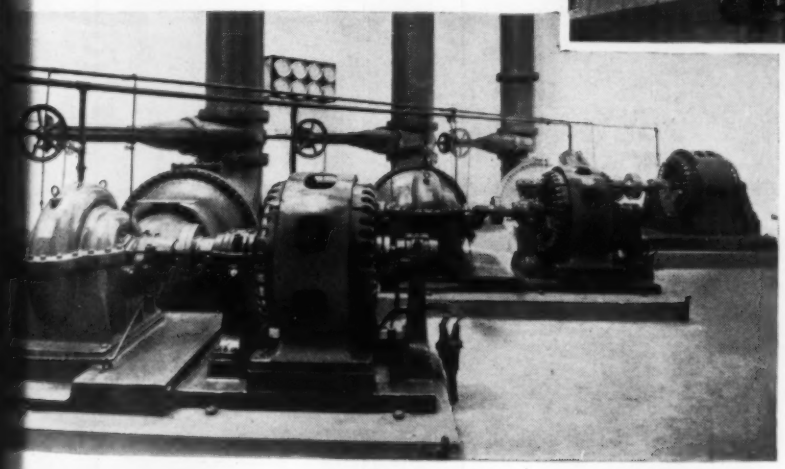
...Westinghouse offers the way to simplify the job. ...om equipment for generation of electrical or steam power, to the most specialized types of drives and control for its utilization, Westinghouse provides a single source of supply . . . one broad pair of shoulders competent to take responsibility for performance of all parts of the job.

Here is one of many examples where Westinghouse unit responsibility is preventing headaches . . . saving money . . . assuring *higher operating* efficiency:

...AIN PUMPING FLOOR of the 120 mgd Bachman ...terworks, City of Dallas, Texas. This plant has 15,225 ... in Westinghouse motors, supplemented by Westing... ...se switchgear and other apparatus. The satisfactory ...vice rendered is evidenced by 12 years' operation with... ... repairs of any kind to electrical equipment, with a ...tenance cost which has averaged less than 2c per hp.

In the center are five 800-hp and one 400-hp Westing... ...se synchronous motors. At the left and right-rear two ...stinghouse motor generator sets (one of which is a ...dby unit) furnish excitation for four 500-hp and three ...-hp Westinghouse motors located in the basement. ...the right is shown part of the Westinghouse controls ... the entire plant.





LEFT: Basement floor, showing three of four 500-hp Westinghouse motors, each of which drive a 30 mgd raw-water pump. Three 900-hp Westinghouse vertical motors, driving clear-water pumps, are also located on this floor but are not seen in this picture.

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

MORE PRODUCTIVE POWER FOR INDUSTRY

(*Continued from page 88*)
tests to determine wear resistance and weathering resistance. The latter tests produce effects in hours or weeks that would take months or years to determine by actual use of the material.

Mathematics Section

The establishment of a separate section composed entirely of mathematicians grew out of the need for a readily available group of consultants to assist and advise scientists and engineers in the theoretical aspects of their ordnance development work. Problems in a great variety of fields, such as elasticity, hydrodynamics, theoretical mechanics, thermodynamics, and others, are continually arising at the station, for which mathematical methods of attack must be studied, devised, and interpreted. In such consulting work the mathematics section fills a vital need.

Another major activity of the mathematics section is concerned with the application of effective statistical techniques in the planning and analysis of tests and experiments. Instruction in statistical theory and practice is provided for station personnel engaged in test work, and service is provided in the analysis of difficult or unusual problems. Recent wartime developments in sequential analysis and quality control are being introduced and applied.

Federal Government's Role in Development of Hydro Energy

(*Continued from page 38*)
The license granted to the Ford Motor Co. June 7, 1923, for a period of 50 years to construct and operate a powerhouse with a capacity of 19,200 hp at U.S. Lock and Dam No. 1 on the Mississippi River near St. Paul Minn., is an example of the licenses granted by the Federal Power Commission.

The Tennessee Valley Authority is authorized to maintain and operate properties owned by the United States in the vicinity of Muscle Shoals, Ala., in the interest of the national defense and for agricultural and industrial development, and to improve navigation in the Tennessee River and to control the flood waters of the Tennessee River and Mississippi River Basins.

The Rural Electrification Administration is authorized to make loans in the several states and territories of the United States for rural electrification and the furnishing of electric energy to persons in rural areas who are not receiving central station service.

Six Bills Introduced in 80th Congress

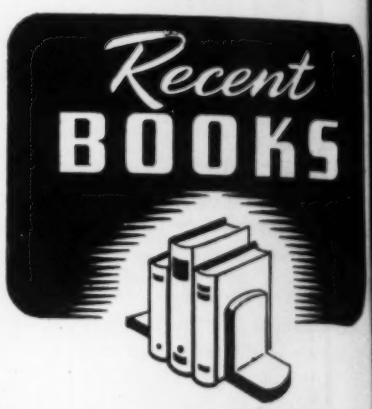
Six outstanding pieces of legislation were introduced in the 80th Congress dealing with the development and disposal of hydroelectric energy by the federal government: (1) S. J. Res. 111, "Approving the agreement between the United States and Canada relating to the Great Lakes–Saint Lawrence Basin with the exception of certain provisions thereof; expressing the sense of the Congress with respect to the negotiation of certain treaties; providing for making the Saint Lawrence seaway self-liquidating; and for other purposes"; (2) H.R. 502, "To provide for the creation of conservation authorities, and for other purposes"; (3) H.R. 3036, "To amend Section 5 of the Act of December 22, 1944 (Public Numbered 534, seventy-eighth Congress."; (4) S. 972, "To declare the policy of the United States with respect to hydroelectric power generated in connection with federally financed water-development projects and to provide procedures for carrying out such policy"; (5) H.R. 59, "To establish the Office of Power Administration for the coordinated administration of all federal functions pertaining to the generation, distribution, and sale of electricity and the regulation of electric utilities"; and (6) H.R. 2873, "To amend certain provisions of the Reclamation Project Act of 1939."

The national interest in the development of hydroelectric energy is indicated by the following extract from the message of the President on the state of the Union, delivered at a joint session of the House and Senate on January 7, 1948:

"We must continue to erect multiple-purpose dams in our great rivers—not only to reclaim land, but also to prevent floods, to extend our inland waterways, and to provide hydroelectric power. This public power must not be monopolized for private gain. Only through well-established policies of transmitting power directly to its market and thus encouraging widespread use at low rates can the federal government assure the people of their full share of its benefits. Additional power—public and private—is needed to raise the ceilings now imposed by power shortages on industrial and agricultural developments."

Field Research Groups Provide Data for Shore Protection

(*Continued from page 39*)
In the shallow water adjacent to the Long Branch pier a step-resistance type of wave recorder and Rayleigh Disk wave direction recorder developed by the Beach Erosion Board are in operation. Seaward of the dump area a pressure-type deep-water wave recorder, developed by the Woods Hole Oceanographic Institution, is used at water depths of 50 ft. This station not only provides basic oceanographic and meteorological information for the study but also maintains radio contact as a navigation aid for the ocean-going dredge so that it can safely proceed into the dump area or stay clear in adverse weather. Data will also be collected on the quantity of sand in suspension at different depths with the board's sampler and on the configuration of the beach and ocean bottom in the project area.



IDRAULICA. By U. Puppini. Nicola Zanichelli Editore, Bologna, Italy, 1947. 678 pp., diagrs., charts, tables, 10×7 in., paper, Lire 2,500. This comprehensive textbook presents the subject of hydraulics in a logical manner, proceeding from the units of measurement and other fundamentals through the general considerations to the more specialized aspects such as the use of models. Bibliographies accompany most of the chapters.

(THE) INDUSTRIAL ENVIRONMENT AND ITS CONTROL. By J. M. Dalla Valle. Pitman Publishing Corp., New York and London, 1948. 225 pp., diagrs., charts, tables, 9¼×6 in., cloth, $4.50. Engineering methods for the control of health hazards in factories are discussed in this book. It presents extensive details on air sanitation and exhaust ventilation. Illumination, noise and thermal environment are fully discussed. The scope of industrial hygiene is indicated, and general principles of industrial sanitation are included. References follow each chapter. No prerequisites other than preliminary engineering and some knowledge of industrial hygiene are required.

MANUAL OF MATHEMATICS AND MECHANICS, 2 ed. By G. R. Clements and L. T. Wilson. McGraw-Hill Book Company, New York and London, 1947. 349 pp., diagrs., tables, 9¼×6 in., cloth, $3.25. This manual contains facts and formulas that are useful in college and engineering schools. In this revised edition the tables of differentials and integrals have been expanded, and the author has included formulas for the solution of spherical triangles by Ageton's method. New material has also been added on the applications of mathematics to certain topics in electrical engineering. A glossary and tables for use in courses in physics are appended.

LORAN LONG RANGE NAVIGATION, edited by J. A. Pierce, A. A. McKenzie and R. H. Woodward. McGraw-Hill Book Co., New York, 1948. 476 pp., illus., diagrs., charts, tables, 9¼×6 in., cloth, $6. A complete account of the design and use of the long-range pulse navigation system known as Loran, both in its original form and as sky-wave synchronized Loran, is covered in this volume. The greater part of the discussion is devoted to equipment now in operational use. Sections are included on radio propagation at Loran frequencies and on methods for the computation and preparation of Loran navigational charts.

RECENT GROUNDWATER INVESTIGATIONS IN THE NETHERLANDS. (Monographs on the Progress of Research in Holland). By W. F. J. M. Krul and F. A. Liefrinck. Elsevier Publishing Com-

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pany, New York and Amsterdam, 1946. 78 pp., illus., diagrs., maps, $8^1/_4 \times 5^3/_4$ in., paper, $1.50. Owing to the need for a controlled fresh water supply and protection from the sea, groundwater conditions in the Netherlands have been continually investigated. In this pamphlet the authors review the geological formation of Holland, and discuss the hydrological investigations made during the war. They describe a glass-plate model developed especially for this research. In the bibliography, both the literature published in Holland since 1939, and the important articles published internationally before 1939 are included.

STRESS ANALYSIS AND DESIGN OF ELEMENTARY STRUCTURES. by J. H. Cissel. 2 ed. John Wiley & Sons, New York; Chapman & Hall, London, 1948. 419 pp., illus., diagrs., charts, tables, $9^1/_8 \times 5^3/_8$ in., cloth, $5. Written primarily as a text for non-civil engineers, this book presents fundamental and practical material such as would generally be of value to an engineer in any field. The section on stress analysis remains substantially the same as in the first edition, but the second section has been rewritten and rearranged in accordance with current practice. A new chapter is included on the design of light-gage steel structures, and the specification material has been revised to conform to recent changes.

SYMPOSIUM ON MEASUREMENT OF ENTRAINED AIR IN CONCRETE, Authorized Reprint from the *Proceedings*, Vol. 47, 1947. American Society for Testing Materials, Philadelphia 3, Pa. 96 pp., illus., diagrs., charts, tables, 9×6 in., paper

Books in the Engineering Societies Library may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains research and photostat services, and can provide microfilm copies of any item in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18 N.Y.

$1.75; to members $1.30. The nine technical papers included in this symposium cover the various methods that have been developed to measure the air entrained in concrete, this quantity of air being subject to variation from a number of influences. There is also a paper giving an analysis of these methods and one on the effect of sampling errors.

TABLES OF THE BESSEL FUNCTIONS OF THE FIRST KIND OF ORDERS TEN, ELEVEN, AND TWELVE (Harvard University, Annals of the Computation Laboratory, Volume 7.) TABLES OF THE BESSEL FUNCTIONS OF THE FIRST KIND OF ORDERS THIRTEEN, FOURTEEN, AND FIFTEEN. (Harvard University, Annals of the Computation Laboratory, Volume 8.) TABLES OF THE BESSEL FUNCTIONS OF THE FIRST KIND OF ORDERS SIXTEEN THROUGH TWENTY-SEVEN. (Harvard University, Annals of the Computation Laboratory, Volume 9). Harvard University Press, Cambridge 38, Mass., 1947-1948. Vol. 7, no pagination; Vol. 8, no pagination; Vol. 9, pp., tables, $10^3/_4 \times 8$ in., cloth, $10 each. These three volumes are continued the tables computed by the Automatic Sequence Controlled Calculator. The tabulation is carried to decimal places, with a wide range of argument and order, fine argument interval, and a degree of accuracy. The Tables are intended be of use not only to mathematicians but in the designing departments of electrical radio industries and in many kinds of laboratories. Volume III of the series describes methods of computation and interpolation.

TIMBER ENGINEERS' HANDBOOK, edited by H. Hansen. John Wiley & Sons, New York; Chapman & Hall, Ltd., London, 1948. 882 pp., diagrs., charts, tables, $8^1/_2 \times 5^1/_2$ in., cloth. Covering all the woods used in this country this book contains the latest information necessary for the design of wood structures. Wood properties, grading specifications, working stresses, preservatives, fastenings, design formulas and methods are presented. Thirty charts, figures, and more than 100 tables illustrate the text and provide useful data. Standard terms are defined and common abbreviations explained. Safe uniformly distributed loads for beams of various sizes and lengths are tabulated in a 500-page appendix.

APPLICATIONS FOR ADMISSION OR TRANSFER

June 1, 1948 — Number 6

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every Member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid it in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character professional reputation of an applicant should be promptly communicated to the Board. Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years
Associate Member	Qualified to direct work	27 years	8 years	1 year
Junior	Qualified for subprofessional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years

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ALLENDE POSSE, JUSTINIANO (Age 61) Private engineering practice and technical writing, Buenos Aires, Argentina.

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CRUM, THOMAS MCKERRELL (Age 41) Prin. Hydraulic Engr., Div. of Licensed Projects, Bureau of Power, Federal Power Commission, Washington, D.C.

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(Continued on page 98)

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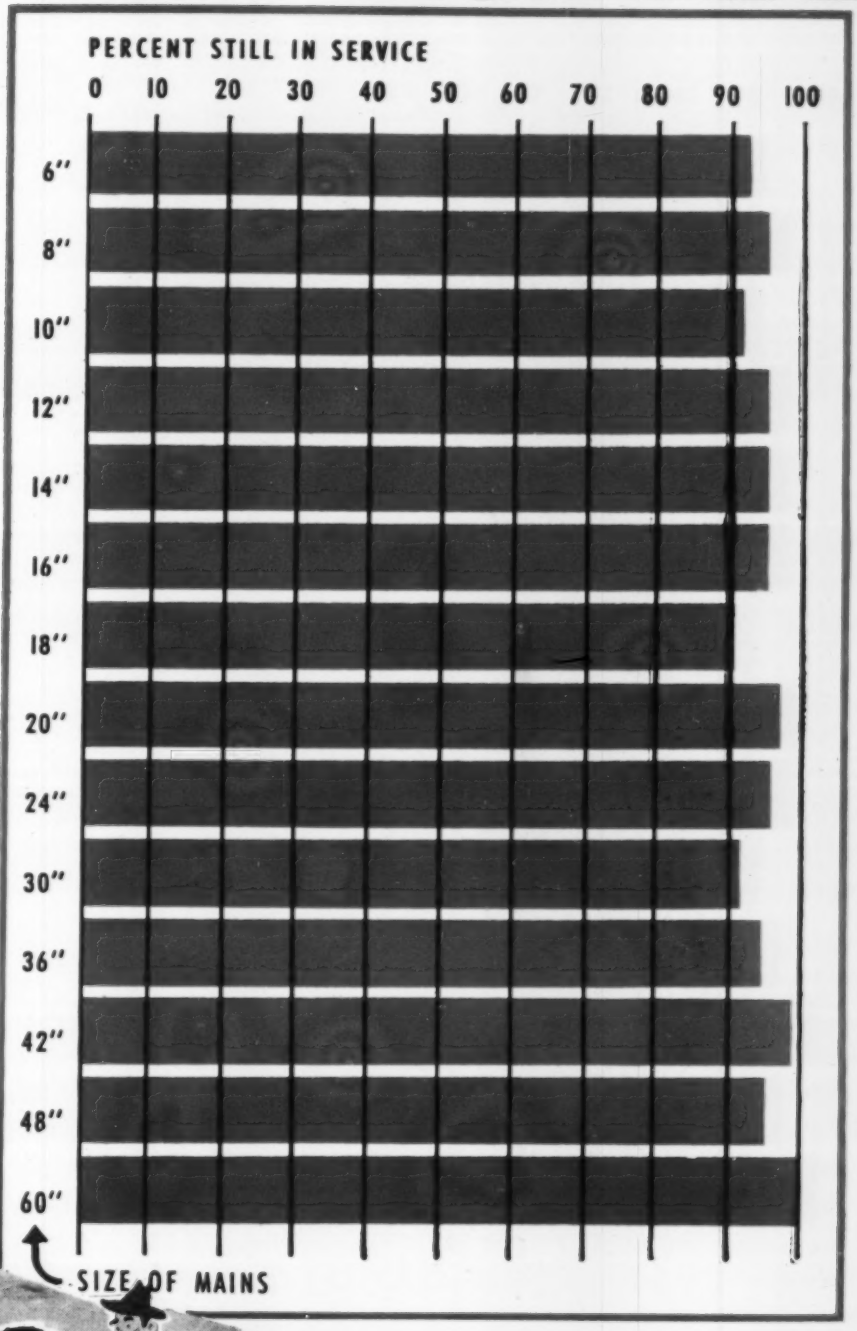

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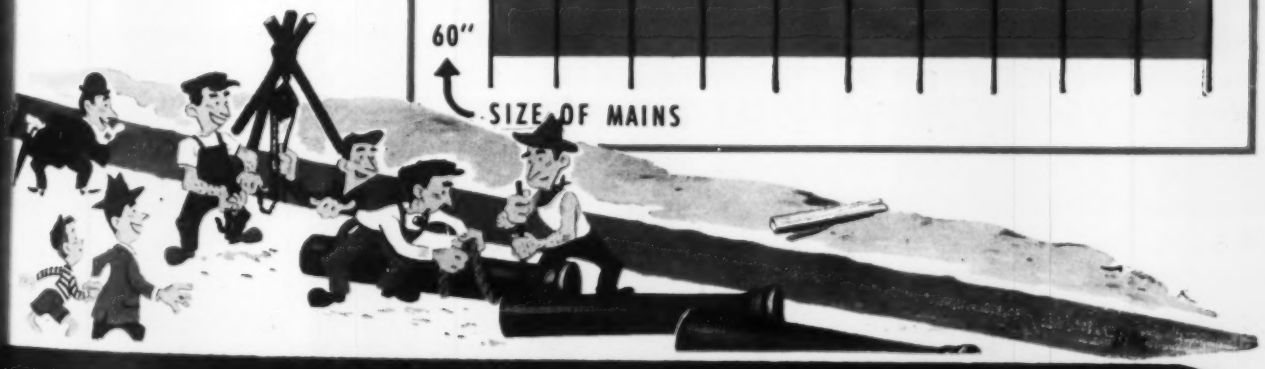

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(Continued from page 94)

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HARRIS, CULLEN FOWLER (Age 26) Engr. Draftsman, Estimating and Designing Dept., Virginia Bridge Co., Birmingham, Ala.

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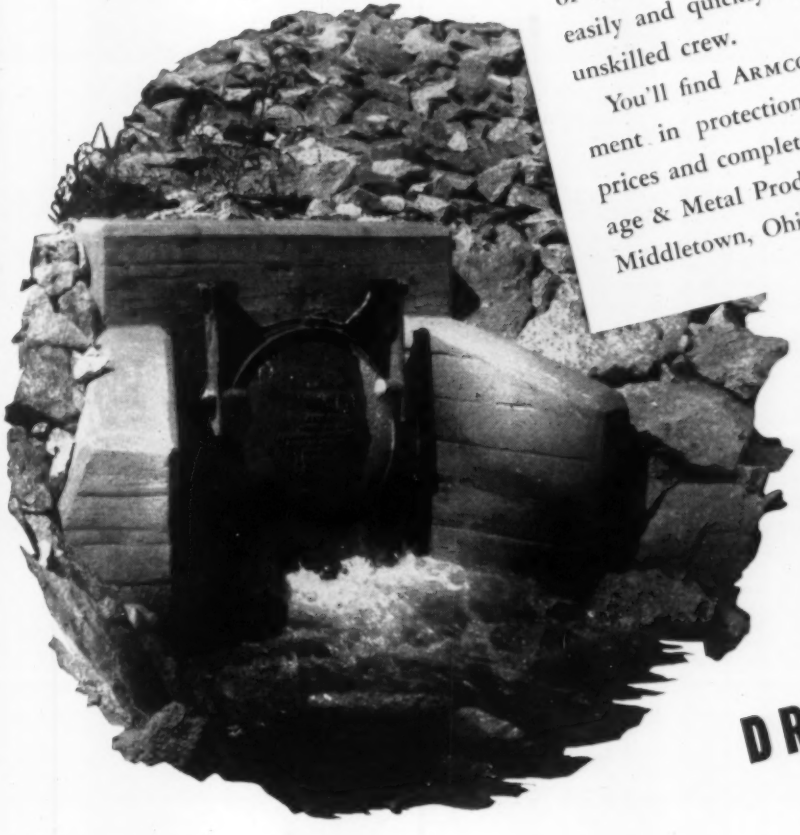

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WEINBERG, BERTOLD ERNST, 1948 (21)

UNIV. OF S.C.

TROTTER, JAMES ROBERT, 1947 (24)

VANDERBILT UNIV.

WARREN, JOHN ARMSTRONG, 1948

The Board of Direction will consider the applications in this list not less than thirty days after date of issue.

CHANGES IN MEMBERSHIP GRADES

ADDITIONS, TRANSFERS, REINSTATEMENTS, AND RESIGNATIONS

From April 10 to May 9, 1948

Additions to Membership

ABRAMOWITZ, DANIEL EMILE (M. '48) Engr., Federal Power Commission, 11 Park Place, New York (Res., 862 East 14th St., Brooklyn 30), N.Y.

AHMAD, MOHAMMAD ANIS (Jun. '48) Graduate Student, Univ. of Tennessee, P.O. Box 4295 Knoxville, Tenn.

AHMED, IFTEKHAR (Assoc. M. '47) Engr., Hyderabad State, State Public Works Dept., Care, Chf. Engr., P.W.D. (Res., Care, Dr. Mahmood Meah, Gulzar Houz), Hyderabad, Deccan, India.

ALBIN, PEDRO, JR., (Jun. '47) Head of Soil Mechanics Laboratory, Secretaria de Recursos Hidraulicos, Guadalquivir 92, Mexico City, Mex.

ALLISON, JAMES SHERMAN (Assoc. M. '47) 839 East Carson St., Long Beach, Calif.

ALSTON, ANTHONY AUGUSTINE (Jun. '47) Junior Civ. Engr., Bridge Dept. Calif., Div. of Highways, Public Work Bldg., Sacramento (Res., 1017 Pleasant Valley Drive, Walnut Creek), Calif.

ANDERSON, BENTON REES (M. '48) City Engr., City of Clinton, City Hall (Res., 1110 Pershing Blvd.), Clinton, Iowa.

ANTHONY, PAUL DIX (M. '48) Asst. Civ. Engr., Board of Water Supply, City of N.Y., 120 Wall St., New York (Res., 293 Rugby Road, Brooklyn, 26), N.Y.

ARZE, ELIAS ALEJANDRO (Jun. '47) Structural Engr., Corporacion de Fomento, 37 Wall St., New York 5, N.Y.

BAKER, FRED HESTWOOD (Jun. '48) Asst. Engr., Robinson Fan Corp., Kern Ave. (Res., 5 North Church), Gilroy, Calif.

BANTON, PEMBROKE CLAYTON (Assoc. M. '48) Estimator and Engr., H. S. Holtze Constr. Co., 2121 East 4th St., (Res., 611 Rebecca St.), Sioux City, Iowa.

BEASLEY, MARVIN CLIFTON (Assoc. M. '48) Chf., Office Eng. Branch, Corps of Engrs., Dept. of the Army, P.O. Box 337, Killeen, Tex.

BELEW, ELMER WALTER (Jun. '48) Junior Constr. Engr. and Estimator, Samuel Kraus Co., 645 Edmund Ave. (Res., 4032 Castleman Ave.), St. Louis, Mo.

BELL, ROBERT EDMUND (Jun. '47) Transitman, Utah State Road Commission, Care, L. M. St. Clair, Box 31, Nephi, Vt.

BERGMAN, RAYMOND DAVID (Assoc. M. '48) Asst. Maintenance Engr., Dow Chemical Co., Styrene Div., Box 500, Gardena (Res., 341 Moline Ave., Apt. 3, Long Beach), Calif.

BERRY, FREDERICK DEAN (Jun. '47) 303 Fayette St., Pekin, Ill.

BERRY, RICHARD NATHANIEL (Assoc. M. '48) Pres., Bay State Constructors, 2 Abbott St. (Res., 57 Glenwood St.), Malden 48, Mass.

BERTACCINI, ALBERT GABRIEL (Jun. '48) 53 West Climax St., Pittsburgh 10, Pa.

BHATE, KRISHNAJI GOVIND (Assoc. M. '48) Executive Engr., Bombay Service of Engrs., Public Works Dept., Govt. of Bombay, Central Offices, Poona 1, India.

BONNEY, ROBERT MILTON (Assoc. M. '48) Design Engr., Moffatt, Nichols & Taylor, 607 Concord Bldg. (Res., 4635 S.E. 46th Ave.), Portland 6, Ore.

BOSCH, HERBERT MICHEL (M. '48) Chf. Section of Environmental San., Minnesota Dept. of Health, Univ. Campus, Minneapolis 14, Minn.

BOWER, CECIL LLOYD (M. '48) Dist. Bridge Engr., Public Roads Administration, 1340 Wilson St. (Res., 4310 Washington Ave. S.E.), Charleston 4, W.Va.

BRANNAN, JULIUS HENRY (M. '48) Survey and Design Engr., U.S. Public Roads Administration, 303 West Jefferson St. (Res., 4701 North 7th Ave.), Phoenix, Ariz.

BRODIE, ROY NORMAN VARLEY (M. '48) Asst. Structural Engr., Boston & Maine R.R., 150 Causeway St., Boston 14, Mass.

BRONSON, REX CARL (Jun. '47) 960 East 9th South, Salt Lake City, Utah.

BROWN, ROBERT FLETCHER (Jun. '48) Development San. Engr., Infilco Inc., 325 West 25 Place (Res., 2955 North Halsted St.), Chicago, Ill.

BRUESKE, ROBERT JOHN (Jun. '48) Instrumentman, C. M. St. P. & P. R.R. Co., Div. Engr. Office (Res., 103 South Center), Miles City, Mont.

BRYANT, HARRY EDWARDS (Jun. '48) Junior Engr., General Electric Co., Hanford Eng. Works, Richland (Res., Gen. Delivery, Grandview), Wash.

BRYON, J. ALVARO (Jun. '47) Gerente, Bryon Ltd., Edificio Degraco, Oficina No. 409, Calle 9a Carrera 4a, Cali, Colombia, S.A.

CARMANY, ROBERT MUIR (Assoc. M. '48) Associate Physical Testing Engr., State Div. of Highways, 3435 Serra Way, Sacramento, Calif.

CHAFFEE, JOHN LYMAN (Jun. '47) Civ. Engr. Aide "A," State Highway Dept. (Res., 119 Maple Park), Olympia, Wash.

CHAUDOIN, DALLAS LESLIE (Assoc. M. '48) Dept. Engr., Constr., Drake-Utah-Grove, A.P.O. #74, Care, Postmaster, San Francisco, Calif. (Res., P.O. Box 426, Wilcox, Ariz.)

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CLARK, JOSEPH RALPH (Assoc. M. '47) Senior San. Engr., Tennessee Dept. of Public Works, Nashville, Tenn.

COLE, CHARLES ALLEN (Jun. '47) Civ. Engr. and Inspector, State College of Washington, Architects Office, Mechanic Arts Bldg. (Res., 109 Shasta, Trailer Camp), Pullman, Wash.

COOK, ROBERT PERRY (Assoc. M. '48) Hydr. Engr., South Pacific Div., Corps of Engrs., Oakland Army Base, Oakland (Res., 2290 North Point St., San Francisco), Calif.

CORWIN, WILLIAM CRAFT (Jun. '48) Engr., U.S. Appraisal Co., 810 Dekum Bldg. (Res., 6132 North Lombard St., Apt. A), Portland 3, Ore.

COTT, SAMUEL MORRIS (Jun. '47) Cadet Engr., Detroit Edison Co., 2000 Third Ave. (Res., 2939 Calvert), Detroit, Mich.

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CROPPER, JOHN RAYNE, JR. (Jun. '48) Junior Civ. Engr., California Div. of Highways, Gen. Delivery, Blythe, Calif.

CURTIS, RUSSELL GREILICK (Assoc. M. '48) Engr., U.S. Engr. Dept., 300 Broadway (Res., 5208 "F" St.), Little Rock, Ark.

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DELK, FLOYD MCLEAN (Assoc. M. '48) Senior Res. Engr., State Highway Dept., 1612 Pierce St. (Res., 3706 Sunset Blvd.), Houston, Tex.

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DOLSON, JAMES WILLIAM (Jun. '48) Junior Track Engr., Pennsylvania R.R., Office of Track Supervisor, Wellsville, Ohio.

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DUDLEY, ROBERT BRUCE (Assoc. M. '47) Engr., L. P. Reed Inc., Meridian (Res., 1609 North 5th St., Temple), Tex.

DUGGAN, CHARLES WAYNE (Jun. '47) Sec., Yakima Cement Products Co., 1202 South 1st St., Yakima, Wash.

DURHAM, LUCIAN ARCHAMBAULT, JR. (Jun. '48) Draftsman, Office of Chf. Engr., Norfolk & Western Rwy. Co. (Res., 2228 Broadway Apt. S.R.), Roanoke, Va.

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EDGAR, ROBERT FRANKLIN (M. '48) Prof. and Head, Civ. Eng. Dept., Univ. of Pittsburgh, Pittsburgh 13, Pa.

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ELTON, EARL WILLIAM (Jun. '48) Bridge Draftsman, State Dept. of Highways, State Hdqrs. (Res., 2501 Otis St.), Olympia, Wash.

ERSKINE, DEMARR MATLACK (Assoc. M. '47) Chf. Engr., W. W. Boxley Co., Boxley Bldg., Roanoke (Res., Route 1, Vinton), Va.

FAUST, EDMOND LAWRENCE (Jun. '47) Corps of Engrs., U.S. Army, District Engr. Office, A.P.O. 942, Seattle, Wash.

FLOR, LOY LORENZ (Jun. '48) Sanitation & Corrosion Engr., La Mesa Lemon Grove & Spring Valley Irrig. Dist., 4769 Spring St., La Mesa (Res., Route 1, Box 75, Lakeside), Calif.

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GEER, ELIHU (M. '48) Asst. Prof. of Civ. Eng., Univ. of Detroit, 4001 West McNichols Rd., Detroit 21, Mich.

GENSEL, LLOYD (Assoc. M. '48) Div. Engr., Public Bldgs. Administration, 303 Post Office, Federal Annex, Atlanta, Ga.

GIBBONS, ASHBY TRICE, JR. (Jun. '48) Graduate Student, Univ. of Illinois, 602 South Wright St., Urbana, Ill. (Res., 349 Blanca Ave., Tampa, Fla.)

GIBSON, RODNEY ERNEST (Assoc. M. '47) Chf. Airport Planning Div., Civ. Aeronautics Administration, City Hall (Res., 600 East 72nd Terrace), Kansas City, Mo.

(Continued on page 104)

10,000,000 Gallons-a-day BONUS!

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...e extends over hills and valleys. ...diameters range from 48" to 96", ...erating under heads up to 550'.

...example of steep grades encountered ...along route of the aqueduct.

...e of installation in deep cuts, which ...were encountered frequently.

With approximately 65 miles of its 71-mile length constructed of Lock Joint Concrete Pressure Pipe, the recently completed San Diego Aqueduct is delivering at least 10,000,000 gallons per day more than its designed daily capacity of 55,000,000 gallons. Based on an investment of some $15,000,000.00, this line is therefore delivering water at substantially less than the expected cost per unit of flow. Extending from San Jacinto to the San Vicente Reservoir, this long gravity line is laid through some of the most rugged country in Southern California. Much of its course is cross-drainage, which necessitated traversing high summits, river bottoms, and deep earth cuts. The problems of terrain alone required the best in pipeline construction in order that the designed carrying capacity would be assured.

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American manufactured over 27 miles of 48", 72", and 96" pipe used in this line. The wide experience of this company in water supply line engineering and construction is available to water-works officials and engineers. Information upon request.

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SANITARY ENGINEER; Jun. ASCE; 26; single; M.S., sanitary engineering, Harvard University. B.S. in civil engineering with honors. Three months' field training, U.S. Public Health Service. One year office and field experience in construction. Interested in public health field. Available September 1948. Prefers West Coast. C-429.

CIVIL ENGINEER; Jun. ASCE; 27; married; expecting M.S. degree in C.E. in June. Three years' diversified experience in surveying, road location, and construction. Desires permanent position as junior assistant to project superintendent or similar position leading to management engineering with well-established firm. Not particular whether location is foreign or domestic. Available June 15. C-431.

This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient nonprofit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

CIVIL ENGINEER; Jun. ASCE; 24; M.S. in sanitary engineering; 3 years' practical experience in structural detailing and design, sanitary surveys, and water purification; desires teaching position in sanitary engineering, hydraulics, and associated subjects. Knowledge of scientific German. Will accept opportunity in industry; prefer eastern United States. C-431.

ENGINEER; M. ASCE; 47; married; no children; 5 years as chief engineer in hydraulics and electricity; sewerage systems, etc.; 3 years experience control and supervision, work shop of machines, cars, and trucks; some teaching experience Desires position in export or teaching. Location, immaterial. C-433.

SALES ENGINEER; Jun. ASCE; 27; married. Experienced structural concrete and steel design. Veteran, instructed at Fort Belvoir, Engineers school. Completed seven months sales training program sponsored by Sales Executive Club of New York. Seeks sales position in construction field. C-434.

CONSTRUCTION ENGINEER; Jun. ASCE; single; 34; wide field and office experience in industrial building and heavy construction. Desires work with a New York construction company. C-435.

CIVIL ENGINEER; M. ASCE; registered professional engineer; 38; 16 years experience in hydraulics, hydrology, flood control, structural engineering, soil mechanics, administration, teaching and research. B.S., M.S. and C.E. degrees. Prefers position in East, Midwest, Canada or Foreign Service. C-436.

CIVIL ENGINEERS: M. ASCE; ACI and two leading engineering societies of Europe; 2 years American practice; 44; single; good background in engineering design and in testing procedure; 16 years experience in design and construction of special concrete works; good European industrial and business connections. Prefers position in New York City. C-437.

CIVIL ENGINEER; Assoc. M. ASCE; 31; married; Canadian graduate with 10 years experience, mostly in dam design and hydraulics. Desires design position. Prefers Canada. Available October 1948. C-438.

Positions Available

TEACHING PERSONNEL. (*a*) Instructor of building construction technology. Experience should include both heavy and light construction, drafting work, surveying or knowledge of construction materials and equipment. Position starts about September 1, 1948. Salary, $4,130 a year. Location, Westchester County, N.Y. W-9961.

CIVIL ENGINEER, graduate, 26–28, single for technical service work for cement manufacturer. Will contact customers and assist with any problems arising. Company will train. Several locations available, all out of New York City. Y-23.

CIVIL OR ARCHITECTURAL ENGINEER, 25-[illegible] graduate, single, to design service stations, houses, office and other small buildings. [illegible] hydraulic calculations and design pumping [illegible] pipeline installations. Write contracts, specifications, and requisitions for materials. Estimate costs on all construction jobs; handle office correspondence relating to requisitions; make economic studies of bulk plant design and location; supervise and lay out miscellaneous small construction jobs at bulk plants. Will be required to train Nationals. Will be required to know Spanish. Salary, $5,640–$7,300 a year. Location, Venezuela. Y-86.

STRUCTURAL DESIGN ENGINEER with at least [illegible] years' experience in the design of concrete, steel and other structures, including API-ASME pressure vessel design, and familiar with California building codes. Should be registered in California or able to pass examination. Must be capable of taking charge of design group. Salary commensurate with experience and ability. Write stating personal data, education and experience. Y-775S.

ENGINEER, 30–40, preferably with experience in a state or county highway department, to take charge of survey, design and supervision of construction of highways and bridges. Position permanent under Civil Service. Salary about $3,600 a year to start. Location, East. Y-[illegible]

SURVEYOR, civil graduate, with pipeline and water works construction experience, to run [illegible]

(*Continued on page 104*)

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Junior Engineer	320–380

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Engineer's degree or professional license, plus varying degrees of experience required. No experience required for Junior Engineer.

Write immediately for details concerning duties, requirements, and examinations, and for application blanks to the **San Francisco Civil Service Commission, 151 City Hall, San Francisco, California.**

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(Continued from page 102)

veys, spot locations and assist resident engineer. Must speak Spanish. Salary, $6,000–$8,000 a year. Location, Ecuador. Y-793.

TEACHING PERSONNEL. (*a*) Civil engineer, preferably with doctorate, but will consider master's degree plus considerable industrial experience to head the Department of Mechanics. Rank of full professor. Salary, $5,000–$5,500. (*b*) Instructor, master's degree, to teach courses in mechanics and surveying. Salary, $3,400. Location, New York State. Y-796.

COLONY ARCHITECT, 28–38, preferably single, with degree in architecture or architectural engineering, with 4 to 8 years' field and office experience. Will act as consultant to the general supervisor regarding plans submitted by colony residents for bungalow improvements. Must have knowledge of residential design, and must be able to conduct a consulting service for the residents. Will take field measurements, prepare shop and construction drawings for alterations to houses, and exterior improvements. Salary, $5,780–$5,820 a year. Location, South America. Y-806.

INSTRUCTOR, master's degree with considerable field and office experience in the construction industry. Location, Missouri. Y-815.

DRAFTSMAN AND DESIGNER, civil graduate, with 5 to 10 years' experience on industrial building, including structural, topographical and architectural design under general supervision. Some traveling. Salary, $4,500–$4,800 a year. Location, New York, N.Y. Y-826.

STRUCTURAL DESIGNERS, graduates, with 5 to 7 years' experience in reinforced concrete and structural steel design. Will work on the board and draw up own design; design specialty in either concrete or steel or both. Salary, $4,200–$6,000 a year. Location, South. Y-832.

DESIGN DRAFTSMAN, civil graduate, with at least 5 years' heavy concrete design experience, to design and lay out foundations, walls, and general heavy construction. Salary, $5,000–$6,000 a year. Location, New York, N.Y. Y-851.

ENGINEERS. (*a*) Stress analysts, 24–28, graduates, with at least 2 years' aircraft experience. Salary, $3,170–$4,680 a year. (*b*) Stress Engineer, 26–35, graduate, with at least 4 years' aircraft experience including one year's group supervisory experience on aircraft structures. Salary, $3,796–$5,824 a year. Location, California. Y-873.

STRUCTURAL ENGINEER with at least 5 years' experience in structural work. Salary, $6,000 a year. Location, Virginia. Y-902.

CIVIL ENGINEERING INSTRUCTORS-Associate Professors to teach Materials and Structures Laboratory and conduct research, mechanics, mechanical analysis, transportation, hydraulics and research. Research opportunities for assistant instructors. Salaries begin at $2,700 for instructors. Other ranks commensurate with training and experience. Location, Mississippi. R-[illegible]

ENGINEERS. (*a*) Superintendent of construction and maintenance, 25–45, civil, mechanical or electrical engineering graduate preferred, with some practical experience, to supervise engineering problems related to receipt, storage, transportation and bulk and retail sales of all grades of petroleum products. Salary, $4,000–$5,000 a year. (*b*) Engineers for main office of same company covering same general field as well as warehousing field in both petroleum and non-petroleum merchandise. Location, Midwest. Y-945.

CONSTRUCTION SUPERINTENDENT AND FIELD ENGINEERS with oil refinery experience for domestic and foreign work. Give complete résumé of experience, training, age, available and salary expected. Headquarters, Ohio. Y-951D.

(Continued from page 100)

GILLESPIE, WILLIAM BRADWIN (Jun. '47) Asst. Engr., Pacific Telephone & Telegraph Co., 14 Peasely Bldg. (Res., 135 Huntington Villa), Longview, Wash.

GINNER, CLIVE ERIC (Assoc. M. '48) Designing Draftsman, Kaiser Engrs. Inc., 1924 Broadway, Oakland (Res., 2336 Marin Ave., Berkeley 8), Calif.

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GO, KONG HOY (Jun. '47) Part-Time Instr., Lingnan Univ., Room 316, Luk Yau Hall, Canton, China.

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GRECCO, WILLIAM LOUIS (Jun.'47) Instr., Univ. of Pittsburgh, 310 State Hall (Res., R.D. 3 Freeport Rd.), Butler, Pa.

GROSS, WILLIAM HENRY, JR. (Jun. '48) Engr. Junior, Structural Dept., Pennsylvania Power & Light Co., 9th & Hamilton St. (Res., 1722 Tilghman St.), Allentown, Pa.

HAASE, WILLIAM Pierre (Jun. '47) 1157 West Chester Pike, Havertown, Pa.

HAFFNER, RAY JOSEPH (M. '48) Gen. Mgr., Metcalfe-Hamilton Kansas City Bridge Co., 67 Broad St. (Res., 935 Park Ave.), New York, N.Y.

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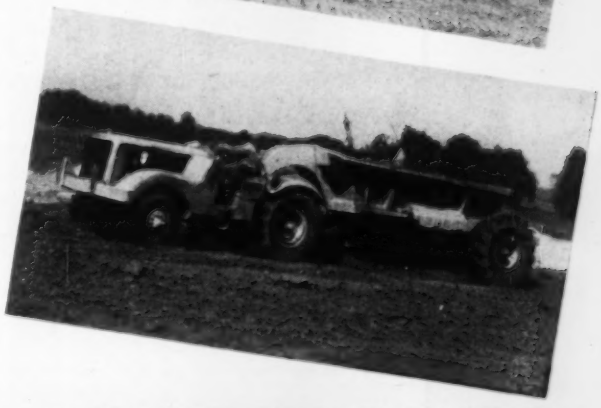

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YOUNG, ROBERT EDWARD (Jun. '48) Junior Civ. Engr., California Div. of Highways, San Diego (Res., 142 South 1st St., El Cajon), Calif.

Membership Transfers

ABILDSO, HAAKON ANDREAS (Jun. '27; Assoc. M. '30; M. '48) Structural Engr., E. I. du Pont de Nemours & Co. Inc., 11502 Nemours Bldg., Wilmington, Del.

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DOSHI, AMRITLAL GHELABHAI (Assoc. M. '46, M. '48) State Chf. Engr. P.W.D., Gondal State (Res., State Engrs. Bungalow), Gondal, India.

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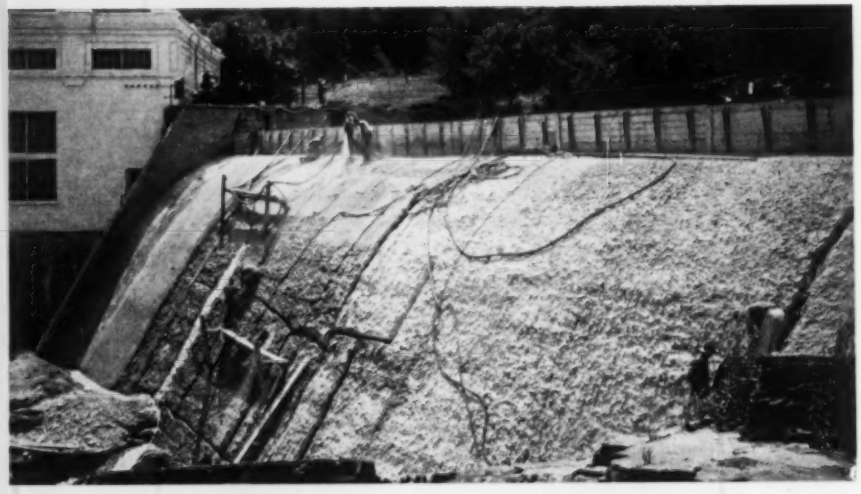

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ZEMAN, JOSEPH MICHAEL (Jun. '41; Assoc. M. '48) Cartographic Engr., Hydrographic Office, Navy Dept., Washington 25, D.C.

Reinstatements

DOWNER, JAY, M., retired; 30 Rockefeller Plaza, New York, N. Y., reinstated Apr. 23, 1948.

DRAGNETT, WILLIAM VINCENT, Assoc. M., Structural Engr., The Linde Air Products Co., 205 East 42nd St., New York (Res., 24 Lenox Terrace, West Orange, N.J.), readmitted Apr. 12, 1948.

HERBERT, JOHN RAY, M., Private Engr., 302 Colwell-Arnold Bldg., Kittanning, Pa., reinstated Apr. 14, 1948.

HILTON, WILLIAM LAWRENCE, Jun., General Contr. (William L. Hilton, Constr. Co.), 4436 East Anaheim-Telegraph Rd., Los Angeles 23, Calif., reinstated May 6, 1948.

MILLER, ROBERT MONFORT, M., 5776 Kenwood Rd., Cincinnati 27, Ohio, reinstated Apr. 12, 1948.

NEEL, WARREN RABUN, M., 69 Alden Ave., N.W., Atlanta, Ga., reinstated Apr. 13, 1948.

SHORT, W. IRWIN, M., Prof. of Civ. Eng., Univ. of Pittsburgh (Res., 2329 McNary Blvd.), Pittsburgh, Pa., readmitted Mar. 15, 1948.

WAGNER, JOHN FORREST, Assoc. M., Civ. Engr., Constr. Div., Veterans Administration, 52 S. Starling St. (Res., 172 W. Lane Ave.), Columbus 1, Ohio, readmitted Apr. 12, 1948.

WAGNER, WILLIAM CHAUNCEY, M., University of New Mexico, Dept. of Civ. Eng., Albuquerque, N.Mex., reinstated May 6, 1948.

Resignations

AUSFAHL, FRED KING, M., 5800 Barrett Ave., Richmond, Calif., resigned Apr. 28, 1948.

BERNS, WILLIAM MAURICE, Jun., 96–09 Sixty-sixth Ave., Forest Hills, N.Y., resigned Apr. 23, 1948.

BROWN, WENDELL STIMPSON, M., 201 Wentworth Ave., Edgewood, Providence, R.I., resigned Apr. 14, 1948.

JOHNSON, WARREN ALBIN, Jun., 4462 Banner Drive, Apt. 3, Long Beach 7, Calif., resigned Apr. 30, 1948.

KESSLER, PHILLIP ARTHUR, Jun., Route 5, Box A-167, West Bend, Wis., resigned Apr. 30, 1948.

WALTHER, WILLIAM EDWIN, Jun., 8166 Prest, Detroit 27, Mich., resigned Apr. 29, 1948.

WAND, ANTHONY WILLIAM, M., 135 Helen Pl., Collinsville, Ill., resigned Apr. 14, 1948.

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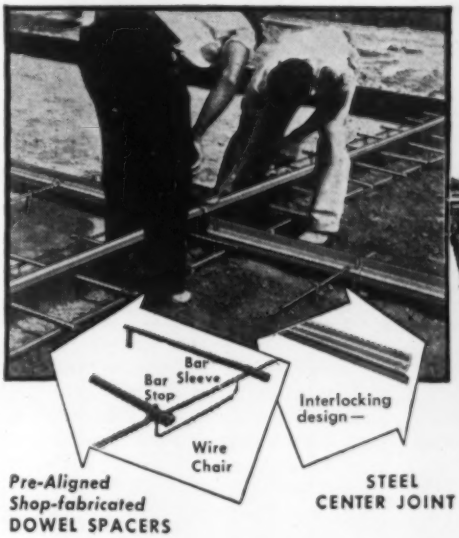

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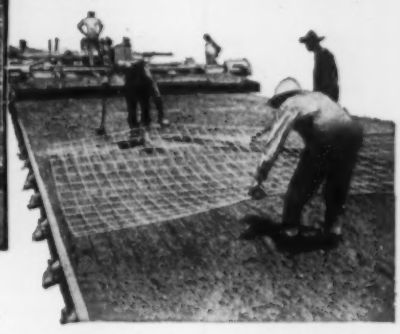

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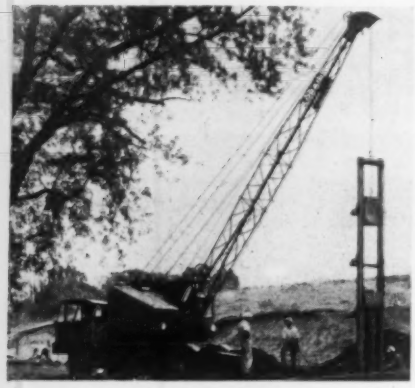

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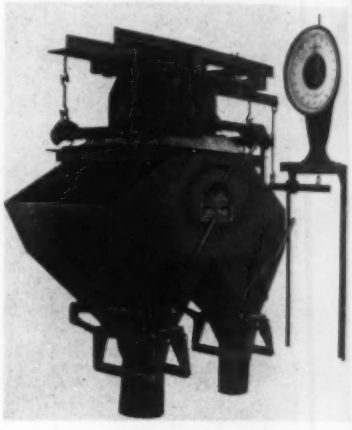

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CMC Construction Equipment

MANY NEW MODELS will be included in a complete line of the products of the Construction Machinery Companies. Among them will be the Jetcrete Gun for pneumatically applying concrete, the Gas-Electric Radial Saw, and a readily portable Batch'N Mix plant. In addition, improved models of concrete mixers and self-priming pumps will be shown. **Construction Machinery Companies, Waterloo, Iowa.**

how do you pick a pump?

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on dependability?

Year after year, Fairbanks-Morse Vertical Turbine Pumps deliver outstanding performance. Fool-proof operation requiring no priming . . . automatic solenoid oiler . . . precision construction for smoother flow . . . and backed by the Fairbanks-Morse reputation for quality, they assure dependability *plus!*

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on service?

The Fairbanks-Morse Pump Dealer organization is founded on service. They *know* pumps . . . can offer you unmatched service and assistance. Backed by the Fairbanks-Morse production and engineering resources, they can help you pick the pump that will give you most for your pumping dollar. Fairbanks, Morse & Co., Chicago 5, Illinois.

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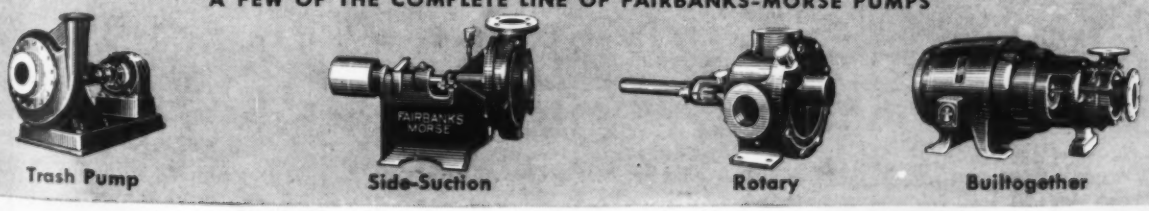
A FEW OF THE COMPLETE LINE OF FAIRBANKS-MORSE PUMPS



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Associate Professor of Soil Mechanics, Massachusetts Institute of Technology

Engineers will find this basic volume a valuable reference work in foundation and soil engineering. The author covers the fundamental material and the theory behind practically all phases of soil mechanics. He explains important soil tests without going into details of testing technique, and emphasizes the scientific approach and the importance of a thorough understanding of soil action.

CONTENTS

Introduction
Preliminary Consideration
Simple Soil Tests and Classifications Tests
Classifications
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Weights, Stresses and Heads, Seepage Forces
Capillarity
Seepage
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Use of Elastic Theory of Estimating Stresses in Soils
Settlement Analysis
Strength Theory
Shear Testing Methods. Shearing Characteristics of Sands
Shearing Strength of Cohesive Soils
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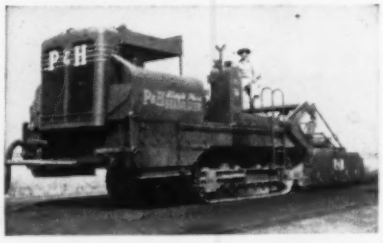
P & H Working Exhibit

A REPRESENTATIVE DISPLAY of P&H's complete line of road-making equipment will include a Model 150 shovel equipped with dual controls so visitors may operate it; a Model 255-A, equipped as trench-hoe; and a Model 255-A truck crane with extra long boom. Largest of the shovels at the show will be a Model 855-B, a 2-yd machine. A Single Pass Soil stabilizer

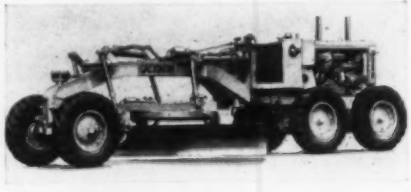


Single Pass Soil Stabilizer

which will be shown will have the rear processing chamber raised and powered by an electric motor so operation of the unit can be seen. A model of the Magnetorque unit used on the 1055 shovel will be in operation. A planetary transmission will be demonstrated and visitors may operate it. Diesel engines and two portable arc welders are also scheduled for display. **Harnischfeger Corp., Milwaukee 14, Wis.**

Galion Motor Graders and Rollers

A COMPLETE DISPLAY of all the equipment manufactured by Galion Iron Works & Mfg. Co. will be on view in sections 2206, 2405, 2408, and 2607. Four sizes of motor graders and seven sizes of rollers will be exhibited. Included in the display will be the following new 1948 models: 116 extra heavy-duty motor grader, 102 heavy-duty motor grader, 201 medium-duty motor grader, 402 light-duty



Model 116 Motor Grader

motor grader, "Chief" and "Warrior" three-wheel rollers, variable weight tandem rollers ranging in size from 3–5 tons through 10–14 tons, and the Galion portable roller. Galion equipment will also be included in the International Harvester exhibit which will be adjacent to the Galion space. **Galion Iron Works & Mfg. Co., Galion, Ohio.**

M&H

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Pipe Line Accessories for Water Works and Sewage Works

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VALVES: A.W.W.A. type iron body, bronze mounted with double-disc parallel seat or solid wedge type. Non-rising stem, outside screw and yoke, or with sliding stem and lever. Also furnished hydraulically operated. Square bottom type operates in any position.

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B & S FITTINGS
CUTTING-IN TEES

M&H VALVE AND FITTINGS COMPANY
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Koehring Machines

THE COMBINED EXHIBIT of Koehring Co. and its subsidiaries will present more than 30 modern machines from a widely diversified line. Included will be at least a half dozen completely new machines. The C. S. Johnson Co. will preview a new portable Lo-Bin batcher, suitable for charging with shovels or front-end loaders. In addition, Johnson all-purpose, 3-compartment aggregate bin, elevating charger, Little Titan scale, and all sizes and types

Model 1005 2½-yd Shovel

of clamshell and concrete buckets will be on display. The Kwik-Mix Co., in addition to its exhibit of bituminous mixers, plaster mortar mixer and 3½- to 16-S concrete mixers, will show a new type nontilting, 3½-S Dandie mixer and a new power wheelbarrow. In the Parsons Co. section will be displayed a modern wheel-type trenchliner, a medium size ladder-type trenchliner, and a completely new, small utility-size trenchliner to replace hand labor for service connection work. The Koehring Co. will show, for the first time, a 2½-yd excavator, a 12-yd hauling unit, a small paver, and a longitudinal finisher with a hydraulically operated screed lift. Other Koehring machines to be shown include the ½-, ¾-, and 1½-yd excavators, 34-E Twinbatch paver, Dumptor and mud-jacks. **Koehring Co., Milwaukee 10, Wis.**

Rex Construction Machinery

HIGHLIGHT of the Chain Belt Co. exhibit at Booths 2605-2406 will be the new and completely streamlined Rex single and double drum pavers showing the Hydrocycle control, the accessibility to moving parts, the streamlined skip, the self-cleaning discharge chute and a host of other new and improved features. A companion highlight will be the Rex Pump-crete (the pump that pumps concrete). This will be shown in operation, moving, elevating and discharging concrete. Other construction machinery to be displayed includes the following: the Rex Hi-discharge Moto-Mixer, Concrete Mixers with "Shimmy" Skips and the entire assortment of Speed Prime Pumps. Besides the above machinery there will be a Rex Chain and Transmission display and a Conveyor and Process equipment display. Movie and slide films will be shown to illustrate Rex construction machinery at work. **Chain Belt Co., Milwaukee, Wis.**

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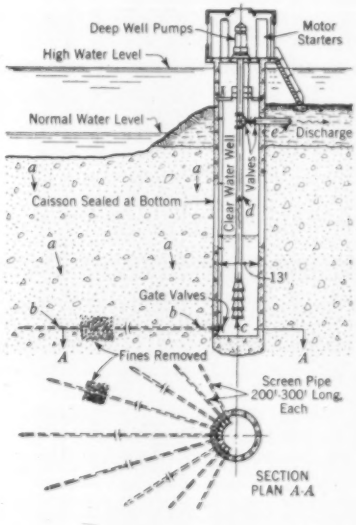

Infiltration

The diagram shows how water from a stream or lake moves into the aquifer at a low velocity. During its movement to the horizontal collector, the water passes through many feet of sand and gravel and emerges clear, cool, and free from pathogenic bacteria.

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Le Roi Equipment

PROMINENT IN THE EXHIBIT of the Le Roi Co. will be the new Airmaster line of compressors. Eight sizes in various mounting arrangements will be shown. The Tractair, a completely integral, completely mobile, tractor-compressor, will be exhibited, and interchangeable front-end equipment for it will be in operation. A special attraction will be the

Trac-Jac and Tractair

Trac-Jac, a mobile, air-feed, sinker drill mounted on Tractair for mud jack work or other shallow hole drill work. A complete line of Le Roi-Cleveland contractor's tools, a Centaur mower for mechanized weed control, and a V-type, 8-cylinder engine providing a wide range of speeds and horsepowers will be included. Rounding out the display will be a cut-away, operating model of the D140 engine, a 10-kw, a-c generator set, and a complete service parts exhibit. **Le Roi Co., Milwaukee 14, Wis.**

I-H Equipment

OCCUPYING 80,000 SQ FT will be the exhibits of the International Motor Truck and Industrial Power products and their allied equipment. Approximately 90,000 additional sq ft will be occupied by allied equipment manufacturers featuring International Industrial Power and International Trucks. Scores of individual displays, including diesel and gasoline-powered trucks, tractors and power units, will provide an over-all picture of what is new in the way of automotive and industrial power equipment. All International tractors will be shown with matched equipment. All of the trucks will be equipped for specific types of work. Included in the Industrial Power display will be five of the giant new TD-24 diesel crawler tractors, each with specialized matched equipment. The new diesel power units, the UD-16 and UD-24, will also be shown. The International Motor Truck display will feature a complete line of light-duty and heavy-duty trucks, including powerful off-highway models. **International Harvester Co., Chicago, Ill.**

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Speaking of ground water . . . When the record shows an almost 100 percent exclusive use of Layne Well Water Systems for the entire United States and Canadian paper mill industry, it is time for the Layne Organization to take a bow. But such is the case and that enviable fact is due to Layne's consistently maintained top flight quality, high efficiency and the important KNOW HOW of modern well water system construction.

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Bucyrus-Erie Equipment

TRACTOR EQUIPMENT for International industrial crawler tractors will be on display at the Bucyrus-Erie Co. exhibit in space 2502. There will also be a photographic display of the company's line of $\frac{3}{8}$-yd to $2\frac{1}{2}$-yd excavators in the Exhibition Hall, Booth 1018-1219. Tractor attachments in the outdoor exhibit include: five scrapers; three cable-controlled 4-wheel units, with capacities of 6, 10, and 15 cu yd; two hydraulic-controlled $3\frac{1}{2}$-yd rear-dump 2-wheel scrapers; two bulldozers for the TD-14 and TD-18 tractors; two Bullgraders, one cable-controlled for the new TD-24 tractor, the other a hydraulic-controlled unit for the TD-9; one Dozer-Shovel, mounted on a TD-6 tractor; and two P-25 rear-mounted power control winches and one front-mounted P-15 winch designed for TD-24 bulldozer or Bullgrader control. New, improved cable-controlled S-type, four-wheel scrapers will be among the units of tractor equipment that will be displayed by the manufacturer and the International Harvester Co. Increased maneuverability is one of the principal features stressed in the design of these scrapers. Models to be included are: the S-46 (4 cu yd struck capacity), S-68 (6 cu yd struck capacity), S-91 (8 cu yd struck capacity). These, plus the 15-cu yd B-170 and the 22-cu yd B-250 make up the Bucyrus-Erie four-wheel scraper line. **Bucyrus-Erie Co., South Milwaukee, Wis.**

5-yd, 2-Wheel Hydraulic Scraper and Bullgrader

Toncan Corrugated Pipe

A COMPLETE LINE of Toncan Iron Drainage products will be on display in Booth No. 1004. On view for the first time as featured items will be the new stronger sectional plate pipe and arches having corrugations 2 in. deep. Full-size, especially constructed display sections will have both circumferential and longitudinal joints to demonstrate the manner in which they are lapped and bolted. Focal point of the exhibit will be a corrugated pipe Culvert model, built to the scale of 3 in. to 1 ft, which will actually carry water. Other products on display will be the Tyton automatic gate, CorWel subdrainage pipe, and a section of 24-in. asphalt paved pipe. **Toncan Culvert Manufacturers' Association, Cleveland 15, Ohio.**

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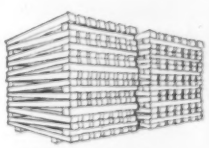

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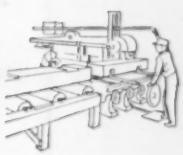

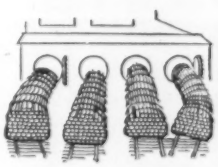

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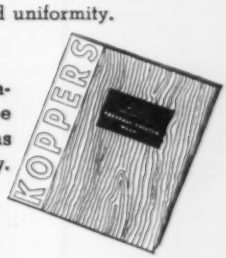

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Kinney Distributor

A 1,000-GAL, Model A Kinney Distributor mounted on a Model EH Mack Truck will be exhibited at Booth 2104. The Distributor has a circulating spray bar, Cartwright type, with a new improved piping scheme to eliminate all cold spots in the lines, and a new system for circulating solvent through the piping system, conserving solvent and giving a better result. The tank has three passes of heat, Alfol insulation, and the cover is aluminum plated to save weight and eliminate rust. **Kinney Manufacturing Co., Boston, Mass.**

1,000-gal Model A Distributor

The Hercules Aircreter

THE PRINCIPAL FEATURE of the Hercules exhibit will be the Aircreter, the new dump body designed especially for hauling and placing of premium-quality, air-entrained concrete. This compact, light-weight unit incorporates an entirely new method of discharge which prevents decantation of lighter materials from the top of the load by permitting a smooth, even discharge of bottom materials first, thus eliminating segregation and bleeding. The machine's light weight, made possible through the elimination of unnecessary mechanisms, permits more direct pours, even on sub-grades. The Aircreter is an all-purpose unit suitable for use by central mixing plant operators, sand and gravel quarries, coal and building supply dealers, dump truck fleet operators and concrete contractors because its design permits use for hauling and dumping materials other than concrete. In addition to the Aircreter, Hercules plans to exhibit several models from its complete line of hydraulic hoists and dump bodies. **Hercules Steel Products Corp., Galion, Ohio.**

B-G Equipment

THE LARGEST EXHIBIT in the history of the Barber-Greene Co., Booth 2203, will introduce many new machines. Set up and ready to work will be the Utility bituminous plant, the first and only completely portable plant of its type in the 60 tons per hour range. With the Utility plant will be the Maintenance plant, a small, bituminous mixing plant specifically designed for maintenance and repair work, small road

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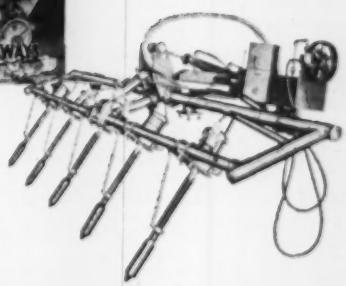

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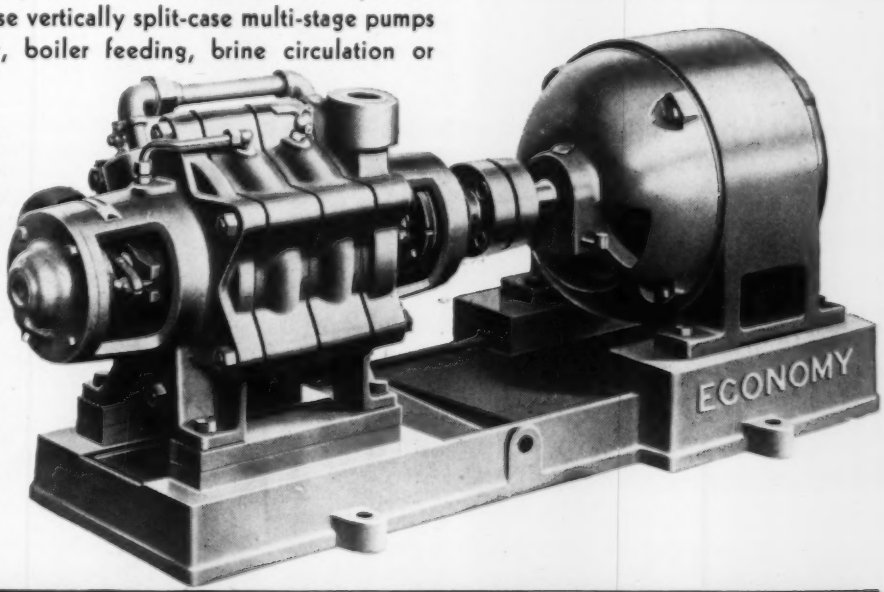

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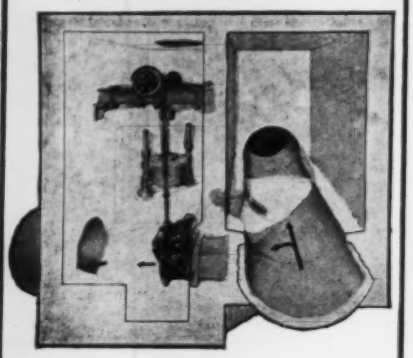

Fig. B-19

Automatic Sewage Regulators control sewage flows either by partially or completely cutting off such flows to suit head or tail water conditions or by "governing" to discharge a predetermined quantity regardless of head or tail water conditions.

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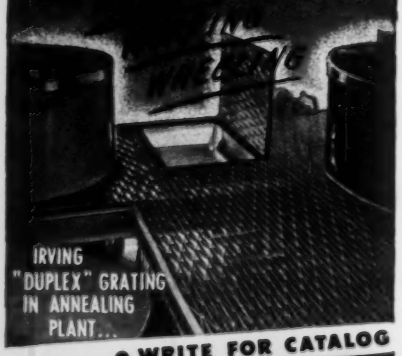

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building projects, and a variety of other surfacing jobs. Other machines to be exhibited include the Model 879A tamping-leveling finisher for properly laying a compact level course of bituminous mix without the use of forms; the new 358 hopper car unloader and the 363 portable conveyor-loader stockpiler; bucket loaders, Models 82A, 545A, and 522; a completely new, small tractor-mounted, highly portable ditcher called the "Runabout" model; the general service vertical boom ditcher; the Model 720 ditcher; and a line of belt conveyors and equipment including the new, heavy-duty, portable belt conveyor whose modern features include pneumatic tires with full swiveling wheels for loading cars, radial stockpiling, etc. As an added attraction, a full-color, three-dimension film entitled, "Highway U.S.A.," will be shown at the Three Dimension theater. **Barber-Greene Co., Aurora, Ill.**

Heil Equipment

THE GIANT HEILINER, a 2-wheel, rubber-tired, diesel-powered tractor and 16-ton, 2-wheel scraper combination will be fea-

Giant Heiliner

tured by The Heil Co. in Booth 3110. Another Heiliner power unit will be shown with the huge 28-ton bottom dump wagon which may be used interchangeably with the scraper. Bulldozers and Trailbuilders (angle-dozers) will be shown and demonstrated, including blades from 9 to 14 ft wide. Also exhibited will be: "Open top," 4-wheel scrapers which eliminate the customary restricting overhead cables and operating mechanism; single and double drum, front- and rear-mounted power control units; and dump bodies and twin-arm hoists which will be represented by 4 operating units ranging from a small contractor's utility body and hoist to a huge rock body. **The Heil Co., Milwaukee 1, Wis.**

Fuller Transmission Units

THE FIRST SHOWING of an extra-large, five-speed transmission, designated Model 5A1120, will be shown in an activated, cutaway version in the Fuller exhibit, Booth 1224. Other Fuller products to be shown include Model 5C650, a 5-speed, unit-mounted transmission; Model 3T92, a 3-speed auxiliary with a full torque power take-off built into the transmission case; an MHA remote control unit exhibited with a Model 5A43 transmission, and forgings manufactured by the Unit Drop Forge Division, Milwaukee, Wis. Both Model 5C650 and Model 3T92 will be cutaway versions, showing the working parts of the transmissions.

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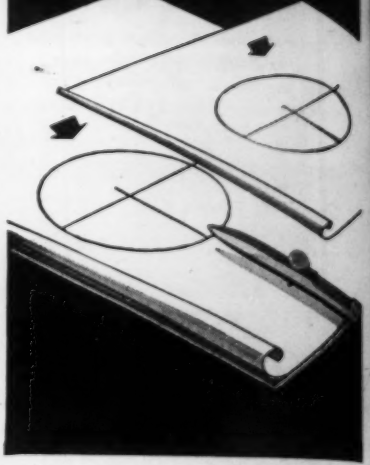

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